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EDUCATION

GENERAL SCIENCE AS PORTRAYED ON STAMPS
By HAROLD F. SCHAEFFER

OUTCOMES OF THE CLEVELAND STUDIES IN SCIENCE
By MARY MELROSE

IMPORTANT CRITERIA IN EVALUATING LABORATORY WORK
By H. I. SCHLESINGER

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EDUCATION

A MONTHLY MAGAZINE

DEVOTED TO THE SCIENCE, ART, PHILOSOPHY AND LITERATURE OF EDUCATION

HERBERT BLAIR, EDITOR-IN-CHIEF
PROFESSOR OF SCHOOL ADMINISTRATION, BOSTON UNIVERSITY

VOL. 56 MARCH, 1936 No. 7

SCIENCE NUMBER

HANOR A. WEBB, EDITOR
CHAIRMAN, DIVISION OF SCIENCE AND MATHEMATICS
GEORGE PEABODY COLLEGE FOR TEACHERS

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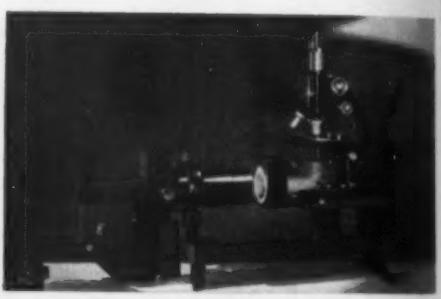

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EDUCATION

Vol. 56 MARCH, 1936 No. 7

"Do science teachers have hobbies?"

This one has! Professor Schaeffer, Head of the Department of Chemistry at Waynesburg College, Waynesburg, Pennsylvania, collects postage stamps that illustrate science. He has already written several articles concerning his unique specialty—here is another one of great interest—more will follow elsewhere. These philatelists are tireless!

GENERAL SCIENCE AS PORTRAYED ON STAMPS

HAROLD F. SCHAEFFER

ALTHOUGH most people fail to appreciate the fact, the unpretentious little postage stamp can serve as a very effective teaching medium. The object here shall be to give a mere intimation of what may be done for the sciences. It is quite true, of course, that in any given field the number of topics covered by appropriate postal issues will be limited; the same applies to any elementary textbook!

Those who record history have always been rather prone to devote much of their attention to exploits of rulers, statesmen and military heroes. It so happens, however, that the first real person concerning whom history records anything of importance, was not a monarch or a conquering hero, but one who has been described as "an artist and a scientist." About three thousand years before the Christian era one of the most important men in Egypt was Imhotep. Primarily he is remembered as a physician and architect, but undoubtedly he was also occupied in statecraft and in religious duties. This first known follower of the science of medicine, the first scientist in recorded history, is depicted on one of the Egyptian stamps (No. 144).[1]

After a span of twenty-five centuries we are brought to the classical period of Greece. In the field of *medicine,* Æsculapius, among the Greeks, occupied a position comparable with that of Imhotep in ancient Egypt. While philately can boast no portrait of Æsculapius, there are available stamps showing his crown and staff (Denmark 453-455).

Louis Pasteur of France, the father of modern bacteriology, has been responsible for saving an untold number of human lives, and the appearance of his portrait on a number of French stamps is a tribute of the nation's appreciation. Practically no country today is too primitive, or too remote from civilization, not to have more efficient medical facilities than were enjoyed by the royalty several decades ago. In this connection a very interesting set of stamps was issued for the Belgian Congo (412-420). The various designs portray a first-aid station

1 The numbers following references to stamps refer to numbers in Scott's Standard Postage Stamp Catalog.

(414), a hospital operating-room (419), etc.

Another science of vital importance to our welfare is *agriculture*. While this has been developed into a very complex industry, it rose from very simple beginnings. One set of stamps portrays a harvest scene in ancient Egypt (160-162). Modern workers, however, are accustomed to much more leisure than their early forbears. This is made possible, to some extent, by the use of labor-saving machinery. A Russian stamp (476) depicts harvesting as carried out with the aid of tractors.

Should we desire to study *zoology* on postage stamps, the material dealing with invertebrates would prove rather meager. There is available, however, at least one interesting life history. In 1930 the republic of Lebanon issued a series of stamps showing the life history of the silkworm. Each stamp in the series (108-113) portrays the caterpillar on a mulberry leaf, a

PHILATELY SERVES SCIENCE

(A) Nicholaus Copernicus, who published his belief that the sun was at the center of things, is honored by Poland. (B) The crown and serpent of Æsculapius, the father of medicine, exemplifies the respect of the Danes for health. (C) Japan has published one of the most beautiful of the map stamps, with Japan appropriately in the center of the world. Note the gull carrying a letter across the Pacific. (D) Imhotep, the first scientist in recorded history, is honored by his native Egypt. He was the architect of the oldest extant pyramid. (E) Many stamps show living creatures; here is an entire life history—that of the silkworm—on one plate. It is issued by the Republic of Lebanon, Syria. (F) Dmitri Mendelejeff and his noted periodic table are jointly honored by this recent Soviet stamp, one of a centennial commemorative issue. The reproduction is one and one-fourth actual size of each stamp. The drawings from the originals were made by J. Clarence Hankins, artist for *Current Science*.

moth and a cocoon. Among the coelenterates Tonga offers one representative, namely, coral (45). Postal issues which portray higher members of the phylum chordata are quite numerous. Representatives of various classes are the following:

Elasmobranchii: Sharks—Eritrea (159).
Pisces: Codfish — Newfoundland (46).
Reptilia: Turtles — Cayman Islands (95); Crocodiles — Liberia (186); Lizard—New Zealand (194); Snake —Liberia (620).
Aves: numerous birds, exotic and common.

Mammalian vertebrates are well represented:

Marsupialia: Kangaroo—Australia (1-10).
Carnivora: Fissipedia: Newfoundland dog—St. Pierre (321); Leopard—Nyassaland Protectorate (38). Pinnipedia: Seal—Newfoundland (200).
Edentata: Anteater — French Guiana (51).
Artiodactyla: Giraffe — Nyassa (401).
Perissodactyla: Tapir — North Borneo (136).
Proboscidea: Elephant—Eritrea (165).
Cetaceae: Whale — Falkland Islands (71).

No doubt a careful search would reveal issues representing orders not included above.

Philatelists with *botanical* leanings will find an abundance of material representing the higher plants. We could include at least one biography by referring to the portrait of Albrecht von Haller. This eighteenth century Swiss scientist was the author of an important work on the flora of his country, and wrote thousands of articles on a great variety of subjects (Switzerland 476).

To illustrate the science of *geography,* philately affords an abundance of appropriate material. There are available maps which represent hemispheres, single continents, individual countries and mere islands. One of the most beautiful representations of the earth is the elliptical projection of the globe on the Japanese issues (192 to 195). Numerous governments issue stamps which bear maps showing their own territory. Among such countries are Russia, Turkey, Salvador, Panama, Paraguay, New Zealand, Poland and Venezuela. An interesting issue is one of Russia, showing the polar regions (733). Little America, in the Antarctic, is represented on our own country's "Byrd" issue (735).

But the study of maps alone does not constitute geography. We would know something about the various corners of the globe; something concerning the flora, fauna, inhabitants, cities, etc. In this respect the postal issues of Liberia are almost ideal. Although the map of this country is not given in detail, we can at least observe its relative location on the "Dark Continent" (233). We are shown a large variety of animals, including the elephant, champanzee, pigmy hippopotamus, antelope, buffalo, crocodile, vulture, egret, viper. Among plants represented are the pineapple, oil palm, pepper plant and coffee. We get a glimpse of a native village, a harbor scene and other places of interest.

It should prove rather interesting to write an account of a "round the world cruise," using postal issues as the source of maps and illustrations of the sights encountered.

Let us next consider the *universe* at large. During medieval times the earth was considered the center of the universe. It was believed that our

own planet remained fixed, while the sun and all other planets revolved around it. True, Aristarchus, a Greek, had proposed a heliocentric theory as early as the third century B. C., but this was not generally accepted. Centuries later (1543) Nicholaus Copernicus (Poland 192), a Bohemian churchman, published his ideas concerning our universe. After careful study he had concluded that the earth and other planets traveled around the sun.

In general, direct references to *astronomy* are not very numerous in the various postal issues. To the author's knowledge the Dipper and the Southern Cross (Cyrenaica 319 and Chile 637 respectively) are the only constellations represented. Since the pagan deities Mercury, Mars and Venus, are depicted on some issues these might be used to represent planets of the same names.

Elsewhere[2] it has been shown that the designs found on stamps of the world can serve to illustrate a fairly thorough course in *chemistry*. An important addition which appeared in 1934 is the Russian series (536-539) issued in honor of Dmitri Mendelejeff. Every student of high school chemistry learns about Mendelejeff's periodic table, which was the first successful attempt to arrange the simple chemical elements according to their properties. An issue of Luxemburg (371) portrays a research chemist at work in his laboratory.

Various phases of the science of *physics* are well portrayed in philately. For years our commonest one cent stamp has borne the portrait of Ben Franklin, who pursued investigations into the mysteries of electricity. In 1929 there was issued a two-cent stamp (654) to commemorate the fiftieth anniversary of Edison's first incandescent electric light. Various European issues bear portraits of scientists who made important contributions to physics. Since the measure of mass is so important to the physicist, it is of interest to find that Leonardo da Vinci (Italy 1027) invented a self-indicating balance. Designs which show practical applications of physics are quite numerous. A more detailed discussion of this science, as portrayed on stamps, has been arranged for elsewhere.

* * *

The foregoing material is by no means exhaustive. It is merely intended to point the direction of an interesting hobby for a scientist. Among other fields one might include engineering, mineralogy, descriptive geology, animal husbandry. Collecting stamps to match special interests is not difficult, but one must have patience. To avoid discouragement the novice will require one very important tool, a stamp catalog.

Should this article enlist a few more people in the stimulating activity of making a science stamp collection, its object will have been achieved.

2 "Philately Serves Chemistry," by Harold F. Schaeffer, in Journal of Chemical Education, Vol. II, pages 259-266 (1934).

"How did it turn out?"

Each of thousands of visitors to the Cleveland Curriculum Centers during the five-year period of experimentation and development has undoubtedly asked the question. Miss Mary Melrose, Supervisor of Elementary Science in the Cleveland public schools, presents a clear, concise account of the Doan School's curriculum contribution, only failing—in modesty—to give her own participation due credit.

OUTCOMES OF THE CLEVELAND STUDIES IN SCIENCE

MARY MELROSE

IN Cleveland we have a very advantageous set-up for developing all phases of the curriculum in the elementary schools. Several years ago assistant superintendent H. M. Buckley designated certain schools as curriculum centers to develop courses of study in the various subjects. Doan School became the curriculum center for elementary science.

The curriculum-center plan gave opportunity for the pupils to be a dominant factor in curriculum making. If a course of study is to meet pupil needs, interests and capacities, what better means can be found than the utilization of the pupils themselves in making a curriculum? Unquestionably the use of one school as a laboratory for the purpose of evolving and formulating a science course of study has proved most practical. It furnished a means of developing a workable and suitable curriculum as contrasted with a theoretical one.

In setting up the plans of the experiment, our first concern was that all of the teachers should have a scientific attitude toward the problem. It was necessary that each one of us look at every phase of the problem objectively. We knew that reliable findings could not be based on opinion, and therefore we initiated plans which required the recording of much data.

One rather unique method of keeping data was by means of a teacher's diary. In this daily record the teacher was to record all the worth-while incidents, the specimens brought to school, the significant questions asked by the children—in fact, to give a concise yet complete picture of the proceedings of the classroom during the science period. We called this record a diary, as the word suggests something personally intimate, and also smacks of frankness and candidness. These elements were so essential in this record.

Our mode of attack at the Doan Curriculum Center was first to get the pupils interested in some bit of science in each grade and then watch to see what would happen. The stage was set; the play was on; but not according to any pre-arranged plot. The children and teachers began to bring in many specimens and objects of all kinds. As time went on the pupils were taught, or at least exposed, to practically the entire gamut of scientific topics, principles and phenomena in the major sciences. This initial panoramic study was an extremely interesting period for both teachers and pupils. It proved to be a very worth-while beginning.

In this short article naturally it will not be possible to give a detailed

story of all that has taken place. Instead, I shall mention briefly some of the factors that have contributed most toward the solution of the problem. Unfortunately, this cataloging of the procedures does not give a picture of the many interesting activities going on in the classrooms. An article by Dr. Hanor A. Webb in the *Peabody Reflector and Alumni News,* April, 1929, gives a vivid description of these.

What procedures were used in developing the science course?

1. Charts were made covering the vast amount of science material that had been studied. This was organized under subject headings and for each school grade.

2. Committees of science teachers from other schools coöperated in trying out different phases of the science work with pupils in their classes.

3. Pupil-interest data were acquired in five ways. At the end of the first year, after the children had been learning about many different phases of this world of science, we asked them to state what topic interested them most. Since then we have asked for these data four times during the year. In this way we get the dominant seasonal interest of each age-grade group.

If these data on pupil-interest were acquired only once, then there might be many things influencing them or throwing them off plumb. The interest might be traced to the enthusiasm of the teacher, to the way it was taught, or to some unusually interesting first-hand experience or observation in connection with the study. However, we thought if such pupil-interest studies were made with thousands of pupils under different teachers, the basic interests would surely become evident, and we have found this to be true. Now we can almost predict the units that will be listed as "most interesting" by pupils in the different grades at different times of the year. At present we have interest data on about 55,000 pupils.

A second method of determining pupil-interest was by analyzing the teachers' diaries. These revealed not only the interests but also the span of interest.

Another way of getting at pupil-interest was that of asking the pupils to write the science facts they remembered at the end of the semester or year. No hint was given as to the subject, organization, or anything of the sort. We felt that the facts appearing on the pupils' papers would be those that had made the greatest impression and therefore of interest.

The children's questions were tabulated and classified. And all the objective material brought to school by the pupils was listed. As these indicated interest on the part of the pupil asking the question, or bringing the specimen, they served as the fourth and fifth ways to detect pupil-interest.

4. One of the most important contributions toward developing the science course has been the analysis of the science concepts down into their simplest elements. We realized the necessity of this in connection with the making of a course of science for boys and girls, and were not content with using only the science concepts upon which high school and advanced science are built. We felt many of these could be broken down into much simpler ones.

In this analysis we found there were certain levels of concepts. For

example, most concepts that were on the level of observation could be incorporated with very young children in the lower grades. The concepts that required inferences to be made from a series of observations were on a higher level. And still more advanced were those science concepts that involved cause and effect. Herein lies the foundation of grade placement in elementary science.

5. We studied all of the objective material that had been utilized or could be utilized in teaching various concepts, and chose those things that seemed to be best adapted to aid in the learning and understanding of the concept. Then we set up learning situations around these objective materials.

6. Our next problem was that of focusing and organizing all of these into big science units. Although some titles of units sounded intriguing, they could not be used, because in them one needed to incorporate too wide a range of concepts, some being too difficult for young pupils.

7. Another agency that has aided in the experiment is the radio. For more than two years one science lesson per week has been given over the radio to pupils of the fifth and sixth grades. These science radio lessons have shown the reactions of thousands of children to units or parts of units. It would have taken years of experimentation in a few classrooms to have learned such definite indicators. The radio offers an interesting set-up for experimentation, as the radio lesson has the controlled elements and each classroom of pupils and teachers provides the variable ones.

Naturally the developing of a science course was only part of the problem. Regardless of the merits of a course, unless it is used it is of little value to a school system. Therefore, let us consider some of the factors that helped incorporate science in all the Cleveland elementary schools.

How was the science course put into operation throughout the city?

1. The many dynamic science situations at Doan School aroused the interest of teachers from other schools. Although it was a new subject to them, many teachers were stimulated to try some of the science units they saw the curriculum teachers using. So science was begun with enthusiasm, first in fifteen coöperating schools, and later in all the city schools.

2. These teachers began science by teaching only one or two units a semester. The following year another unit was added. This progressive process made it rather easy for teachers to become initiated into the teaching of science. Such a gradual beginning gave the teacher time to become familiar with the subject matter in a few units at a time.

3. Many of the science units have been mimeographed and distributed to the schools. These contain the method as well as the content for the unit.

4. A new time schedule allotted the same amount of time to elementary science as to history. The time distribution per week is—Kindergarten, 25 minutes; First grade, 30 minutes; Second grade, 50 minutes; Third grade, 60 minutes; Fourth grade, 90 minutes; Fifth grade, 120 minutes; Sixth grade, 120 minutes.

5. Most of the Cleveland elementary schools are organized on a departmental basis in grades 4, 5 and 6. Thus the teachers preparing to become

science teachers can give their entire attention to this subject. They may take extension courses in science, become familiar with science books for pupils as well as those by authorities in the major fields. In fact, it gives the teacher an opportunity to become a specialist in science and the teaching thereof.

Practically all fourth, fifth and sixth grade pupils are taught science by science departmental teachers, 250 in number. There are also about 850 teaching science in the lower grades, in addition to all kindergarten teachers.

6. Doan School also serves as a training center for science teachers. Many have been transferred from the center to teach the subject in other schools. Thus Doan forms the nucleus for the development of science teaching, as well as the development of the science curriculum.

7. The science radio lessons have proved especially effective in putting the science program into action. These lessons actually constitute an active science course. As the broadcasts are weekly, they project the week's work for both teachers and pupils. They also give suggestions of many techniques to be used in the teaching of science.

Thus it is easily seen that the accomplishments in science in the Cleveland elementary schools are due to the interest, enthusiasm and hard work on the part of many teachers and principals in Doan and other schools.

MAINE TIDE

The grave, rich afternoon is suddenly a-glint,
The bay's flat immobility is burst.
The sunken sea awakes, and there is signal
For the gathering of gulls, and arrowy flights
Of medricks at the black nets of the weirs—
Red-beaked, on tipsy wings they dart and dive
In shrill pursuit of herring.
Now comes the tide-wind in the spruce
And a weltering of white-caps off the point.
Far out, the ragged girdles of the islands
Are drawn beneath the flood, the giant weight.
The lazy seals roll from the sun-baked rocks—
With ebony shoulders glistening, they plunge
In gutteral ecstasy.
Broad foam-edged discs of silver slither on
The flats and lift the dories up, and lick
The lines of salt-encrusted lobster-pots.
Beside the muddy margin of the cove
Two herons stand incredibly alert
And watch the many-fingered water creep
Through boulders washed with weed.

And now, long miles from this, my eyes still see
The cleanly tumult, and I faintly hear
The tangled rhythms of a distant tide.
Through inland dust I see the flash of gulls
And to my nostrils summon back the salt—
The mesh of whitened water in the rocks
Is with me presently!

NORRIS POTTER, JR.
Assistant Professor of English
Northeastern University

"Shall we abandon laboratory work?"

A distinctly thoughtful analysis of the question persuades Dr. H. I. Schlesinger, veteran teacher of chemistry at the University of Chicago, that the answer is "No" for the right kind of laboratory instruction.

IMPORTANT CRITERIA IN EVALUATING LABORATORY WORK

H. I. Schlesinger

THE present movement in favor of the substitution, in elementary courses, of lecture and small group demonstrations in place of laboratory exercises performed by students, is more than a mere line of least resistance to the demand for economy in school administration. The supporters of the movement include many experienced and excellent teachers who, dissatisfied with the results of laboratory instruction, have turned to other methods. There are others, however, who remain convinced that there is a value gained by doing things for one's self that may not be gained in any other way. These cannot leave out of consideration the eagerness with which students approach laboratory work; they cannot forget that the inspiration for important scientific careers came from these early contacts with laboratory experience. If laboratory exercises have become mere mechanical routine, and the students' interest therefore soon flags, if inspiration is now lacking, then there must be some serious malady in our laboratory work. But the competent physician, observing symptoms of disease in his patient, does not forthwith decide to put him out of his misery; he seeks to diagnose the disease and to find a cure.

In this instance the cause of the disease is not hard to find; the cure, as is usually the case in an illness of long standing, will require much thought and ingenuity, and cannot be effected over night. In the earlier days of science teaching, small groups of ardent students met with a master to learn, in the laboratory, the facts and the principles of science. The growing importance of the latter began to attract larger numbers of students; the facts to be learned also became more and more numerous, and the simple relationship of master and disciple had to be abandoned. Gradually the laboratory lost its original function, and became merely the handmaiden of the lecture. No longer did the student participate as an apprentice in new discovery; his work took on the character of pure repetition intended to illustrate and clarify principles discussed in the classroom, to give a feeling for the reality of science, to make facts easier to learn and to remember, and to develop some technical skill.

Even greater have been the changes in the function of science in the curriculum. Formerly reserved for those students who required it for their professional careers, science has now become a part of the general education of everyone who desires acquaintance with important modern currents of thought and with factors which play an important rôle in our economic and social development. Acquisition of

skills, and acquaintance with specific materials, have therefore become less important in elementary science teaching; science is now so much a part of everyday life that its "reality" is apparent to everyone.

These and other objectives of present-day laboratory work, though they must never be neglected, have nevertheless receded in relative importance. But the new function of science in the school and the college has not destroyed the value of laboratory experience; rather it has brought to laboratory work a new and greater importance. The disease from which laboratory instruction now suffers is a failure to realize and to meet these new responsibilities; the cure is to base on its new function the criteria by which we must, as teachers, judge the success or failure of our work.

General education, of which science is now a part, includes not only factual information and acquaintance with the principles of the natural and social sciences and of the humanities, but has as one of its primary objectives training in the powers of clear thinking. Most of the problems which confront mankind require, in addition, a wise choice of premises and a check on the conclusions reached. In both of these, accurate observation is of the utmost importance. Furthermore, most students are preparing for a life of action rather than one of contemplation. General education should therefore provide training in how and what to see, and in translating observation and thought into well-considered action.

Laboratory work, as at present organized, does not in general pay enough attention to these objectives. The experiments do not give training in unbiased observation because most of them are of such character that the student can predict what the result will be. The experiment is not designed to let him discover something new; it is planned to illustrate something already learned. Furthermore, development of confidence in the student's own powers of observation is not sufficiently stressed, because he is seldom placed in a position in which he must rely upon himself, rather than confirm his results by those obtained by close neighbors in a crowded laboratory.

A second difficulty arises from the fact that students can accomplish nothing in the laboratory until they have acquired certain essential though simple techniques, and have become familiar with some of the less complicated methods of experimentation. Without direction they flounder and waste their time, consume extravagant amounts of expensive material, and ruin much apparatus. For this reason, elaborate laboratory manuals with very detailed directions for practically every experiment have been prepared. The process has been carried too far. Seldom has the student an opportunity to devise any experiment for himself; even more rarely is it demanded that he do so.

If laboratory work has, as here suggested, objectives which are more or less distinct from those sought in the classroom, the attainment of these objectives should be tested by criteria applying primarily to the laboratory work. The organization of the classroom phase of the course is considered unsatisfactory unless understanding of any given topic demands more or less thorough understanding of those previously discussed. Similarly

an attempt should be made so to organize the laboratory course that successful carrying out of the later experiments is based on the skills, the methods, and especially the point of view developed in the earlier ones. As most laboratory work is now arranged, the student after four or five weeks is ready to carry out all of the remaining experiments of the manual, irrespective of their order. Of course, he could not answer the questions based on the work of the text, but that has no bearing on the question of what the laboratory work has done for him. The significant point is that nothing is being done to develop his ability to analyze a situation and to devise procedures for meeting it.

According to the objectives outlined in the foregoing, the criteria for the success of an elementary laboratory course should be sought in the students' increasing accuracy of observation, increasing ability to use data and knowledge in drawing conclusions, and increasing independence in planning tests to check the conclusions drawn. Consequently, aside from the experiments needed to develop the minimum essential technique, and those advisable to illustrate certain principles and to clarify difficulties, emphasis should be placed on experiments of such character that they must be carried out independently and have results not readily predicted by the student. To these should be added the solution of simple problems by experimental means which the student must devise. To develop such experiments and adapt them to large classes and limited appropriations is a difficult task which will require a great deal of time. A few have been tried out at the University of Chicago; others undoubtedly are being tested by other groups of instructors. Space permits no more than a brief description of one of these.[1]

The student is instructed to obtain three samples of material from the assistant, and is told that each may be either a chloride, a sulfide or an oxide, of some metal. His problem is to observe the behavior of each sample when it is heated in a stream of hydrogen. He is given simple directions for the procedure, and for testing for hydrogen chloride, hydrogen sulfide and water. From his observations he is to conclude, insofar as is possible, which substances were placed in his hands. To aid him in drawing his conclusions, he is given two tables: one of these lists certain properties of a fairly large number of chlorides, oxides and sulfides; the other gives the properties of products obtainable by the reduction of the compounds described in the first table. The student cannot know what he is expected to see, because he does not know with what substances he is working; he must develop confidence in his own results, because no one in his group is likely to have the same set of "unknowns." He must draw his own conclusions, and must test their correctness by procedures he plans on the basis of the properties described for the possible products. Some of the substances included in the list undergo, when heated with hydrogen, no changes other than those which occur when they are heated alone. In

[1] A few other experiments of this type are mentioned in an earlier article by the author, J. Chem. Ed., 12, 524 (1935).

a previous experiment the student has had contact with methods for studying such changes. The experience gained in the earlier experiment must be used in the later one to avoid the drawing of erroneous conclusions.

This experiment has been described merely to make more concrete the objectives and criteria herein advocated. Others must be developed to demand of the student not only selection of properties to be examined, but choice of reagents, and finally selection of experimental procedures. Such experiments necessarily require more time for their performance than do those for which detailed directions are given, but the resulting decrease in the total number of exercises will be a gain rather than a loss. The more this type of work is introduced into the course, the more nearly will the latter meet the objective of training students "to see, to think and to act," and the more value will it have, not only for the prospective science student, but also to the one seeking to broaden his general education.

"Is apparatus a substitute for books?"

Science students may be reading too little, according to the observations of Superintendent J. T. Giles, State High School Supervisor of Wisconsin, who believes that schools should train "lay scientists" who will appreciate practical literature.

REORGANIZATION OF HIGH SCHOOL SCIENCE TEACHING — LABORATORY OR LIBRARY?

J. T. Giles

IN the reorganization that is now going on in secondary education, what are the changes to be expected in the teaching of science? In order to answer this question we must know what are the forces that are working to modify the educative process as a whole, and the secondary school in particular. These forces are both social and psychological.

Historically the major function of the academy and of the early high schools was preparation for college. This was accomplished, it was believed, by training the mind. The theory of mental discipline was quite generally accepted, and Latin, Greek and Mathematics were the approved means by which the mind was trained. The student body was highly selected to start with, and the sifting process was continuous throughout, so that only the brightest pupils survived.

In the beginning years of the twentieth century, psychologists began to abandon the old faculty psychology and with it the dogma of mental discipline. Doubt was cast upon the amount of transfer from textbook to life activities. A new theory of knowledge began to arise, that it is not something to be learned by transference from book to mind—how could it be?—but is something resulting from the interaction of organism and environment. Each learner manufactures his own peculiar brand of knowledge. This means that learning is not the passive absorption of information as formerly believed, but an active, dynamic process which involves the whole person of the learner.

About 1916 a national committee began trying to state the goals of secondary education in terms of life-areas, such as home-membership, vocations, leisure-time activities, institutional living, etc. These were the famous cardinal principles, accepted quite generally in theory, but in the classroom the knowledge objective still persisted. The high school science curriculum had been solidified around the textbook and the laboratory, and, backed by the conservative forces of college entrance conditions, teacher inertia, departmental interest and tradition, the curriculum has yielded slowly to the pressure for change. Several other departments of the school, those dealing with language, literature, home making, business, and the social studies, for example, are moving faster toward reorganization than are the natural sciences. It seems strange that this department should have failed so signally to apply the method of scientific inquiry in its own reconstruction.

Again, there are the social changes taking place in the secondary school, chief of which is the unprecedented increase in enrollment, with its tremendous implications for democracy. Doubling approximately each decade since the nineties, it now enrolls essentially "all the children of all the people." No longer is there social or cultural selection, and no longer is the dominant aim preparation for college. Perhaps only a fourth of those who enter high school ever reach college. Those who do *are*, and probably should be, highly selected. So long as the college retains its traditional aim and curriculum, a minor function of the secondary school would seem to be the selection and guidance of those adapted to do college work. The major function is, of course, education for living—personally, socially, occupationally, recreationally. What are the curricular means and the teaching methods by which we may achieve this goal? That is our problem.

Finally, we come to the more recent developments in our understanding of the nature of the learning process. After many years of scientific research, accompanied often by unscientific debate, we have come to believe that the products of learning are utilized only when the learner recognizes the similarity between the original learning situation and the new situation in which they may be used. Leading psychologists still differ as to the means and extent of "transfer of training." They are agreed, however, that a responsibility rests on the teachers for making the pupil conscious of the need and possibility of using his new learnings in further experience. We need to know the actual use being made by former pupils of their high school learnings, for we can no longer rest serene on the old faith in transfer from schoolbook to life. This is a disturbing discovery.

Another modern discovery of vast educational significance is the commonplace proposition that learning is goal-seeking, or in other words, that we learn what we want to learn. We have believed in the past that learning could be coerced, and that lessons could be assigned, irrespective of the pupil's desires in the matter. But modern educational theory is building on the foundation of human wants. Each individual is driven by the basic forces of desire for approval, social importance, security, etc., to seek those

things which will add to his system of values, and to avoid as far as possible those things which oppose them. We call these values "the pupil's interests," and they are all-important for education. But they cannot be forced; we cannot compel interests in others. They are contagious and may be caught; they may be suggested, but not assigned. Strange, is it not, that we should not have discovered these things sooner?

Putting all these items together we get a new basis for reconstruction of secondary education. Emphasis shifts from college to life, from textbook to experience, from teaching subjects to directing learning, from discipline to interests, from knowledge to activity, from coercion and assignment to suggestion and guidance, from passivity to purpose. The school becomes less formal and authoritative, the teacher more friendly and sympathetic. The curriculum ceases to be dictated from above and becomes a coöperative enterprise in which the pupil plays an increasingly important rôle. It is more flexible, personal, and individual. Large class groups may still learn much from lecture, demonstration, and picture, in school as they do outside, but the best thinking is done in small, social groups, both in school and out. This device of the small study-group within the larger class-group offers possibilities which have only recently been recognized. It is the method *par excellence* for solving problems.

Now what are the implications of all this for high school science? In the first place, it seems to me, we must find out what John and Mary, who have recently had these courses in the school, and who are now at home, on the farm, in the filling-station, at work or at play, or even in college, are doing with science, or might profitably do with it. We hope, of course, that they are continuing their science education. But we know that most of them are not doing it by textbook study nor by laboratory experimentation. They have become lay users of science rather than specialists, their needs are general rather than technical. If they are growing at all in the understanding of their physical and biological environment, it is largely by using such meaningful vocabulary as they possess in reading, listening and observation to increase that understanding. We should know, as far as we can, what these activities are.

Briggs has often reminded us of the need for starting pupils to doing in school those desirable things which they will probably do when school is out. This is one way—the best way, I think—of assuring the transfer of classroom learning. One of the chief objectives of high school science is unquestionably to give greater meaning to the world around us. These meanings are expressed by words which denote relationships. Wide understanding necessitates an extensive vocabulary which is best acquired, no doubt, by extensive reading and conversation. I am not arguing against the textbook and the laboratory. They have essential functions. But they are better adapted to the scientist, the specialist, than to the layman, and they need to be supplemented in the high school by the library. The chief use out-of-school John and Mary are making of their science is in their

reading. We can start them to doing that better in school and guide them better than we have in the past.

It is not even necessary to have an extensive science library in the school, although that is desirable. Out of school the pupil must choose and find his own books. He should have guidance and practice in school in doing just that thing. Too often, I fear, we have spoon-fed our pupils by handing them books until they have become more teacher-dependent rather than self-dependent. This has been more true of literature and the social studies, however, than of science. Here the text and the laboratory have been thought sufficient. But teachers have found, where they have tried, that, in addition to the school library, there are home libraries, public, city, and county libraries, and state traveling or extension libraries at the service of those pupils who know what they want. This is a new and promising field for the teacher of science, the possibilities of which have not yet been explored. To many persons, books are their most precious possessions, keys that unlock the meaning of the world.

We have spoken of those historical changes in secondary education which have resulted in a cosmopolitan school population, of the rise of a new education based on a modern psychology of learning, and of a resulting shift in the function of the school from preparation for college to that of intelligent and effective citizenship, occupational orientation, and leisure-time recreational and cultural activities. In this reconstructed curriculum of the public high school, science should contribute largely to the desired outcomes. It would be strange indeed if, throughout these basic changes in the composition and function of the high school, the traditional instruction in science could persist unaltered. It is time that the leaders in science education in the secondary school attacked more seriously and in a scientific manner, as other departments are doing, the underlying problems of teaching method, of learning technique, and of curriculum reconstruction. When this is done, I am convinced that the laboratory skills will be subordinated to a wide acquaintance with books available for later leisure hours.

"What science shall we teach to our little folks?"

This question is answered, in California, by a smooth coöperation of science specialists in the publishing of most practical guides, and we asked the coördinator, Miss Helen Heffernan, Chief of the Division of Elementary Education, California State Department of Education, to tell us how it is done.

A STATE-WIDE PROGRAM OF SCIENCE EDUCATION IN ELEMENTARY SCHOOLS

HELEN HEFFERNAN

MANY educators believe that science has not been accorded its deserved place in the elementary schools of the past. The most frequent explanation of this is that teachers have not had sufficient or suitable training in science content or in specific methods of presenting science materials to elementary school children. To teach science to young children as science is presented in the majority of college courses would be to court failure.

Elementary teachers have been confronted by a lack of science materials organized on the child's level of maturity and understanding. Reference materials in natural science too frequently treat subjects not immediately available in the child's environment. In developing the science program for the elementary schools of California, it was also apparent that natural science reference material had been prepared by writers in the eastern United States, and California materials had received customarily only incidental treatment.

Purpose of the Science Program.

The purpose of the science program as it is being developed in California is not so much "starting boys and girls on the road to becoming scientists and naturalists as in training them to become educated laymen."[1] It is designed primarily to stimulate in the child interest and appreciation of his environment and to lead him into the realization of his responsibility for its intelligent use.

To the child in whose education nature and science have occupied a significant place, life is a richer and fuller adventure. All seasons are engrossing. The interest developed in school years provides a permanent source of adult enjoyment. The mysteries of nature become increasingly attractive as the maturing mind appreciates the relationship of man to the universe. The teacher who builds a knowledge of and a scientific attitude toward the natural phenomena which is everywhere about the child, has immeasurably enriched his life and equipped him with a never-failing source of relaxation and contentment.

The California Program.

The growing interest in science instruction in the elementary schools throughout the United States is unquestionable. New courses of study in science have been produced by many states and numerous county and city school systems within recent years. Institutions for the education

1 Gerald S. Craig. "Certain Techniques Used in Developing a Course in Science for the Horace Mann Elementary School." New York: Bureau of Publications, Teachers College, Columbia University, 1927, p. 12.

of teachers have added science courses designed to aid teachers in making use of science materials.

In 1932, California published *A Suggested Course of Study in Science for Elementary Schools.*[2] It does not present a rigid course of study, to which all schools of the state were required to conform. It was issued to guide teachers in schools which did not emphasize science in the course of study, and to stimulate curriculum departments to the preparation of suitable local materials.

The detailed outline has been organized in accordance with the following plan:

1. Content is outlined in terms of subject matter objectives.
2. A suggested procedure for teachers and pupils is given for each unit.
3. References for teachers and pupils are indicated.
4. Units have been selected from the various fields of science.

The advantages to be derived from the use of a well-organized course of study are numerous. A more unified, balanced treatment of significant topics is assured. Definite preparation can be made in connection with units selected, and the casual contributions of children can be utilized without having them become the determining factor in the science program.

All curriculum material should be constantly undergoing study and revision. At the present time a large state-wide committee on science education is studying the present program and making long-term plans for its effective continuation, expansion, and improvement.

The Science Guide for Elementary Schools.

In August, 1934, the State Department of Education began the publication of a series of bulletins under the title, *Science Guide for Elementary Schools. The Science Guide* is published monthly except June and July. The following titles indicate the scope of Volume I, published during 1934-1935:

No. 1, August—*Suggestions to Teachers for the Science Program.*
No. 2, September—*Pets and Their Care.*
No. 3, October—*Common Insects.*
No. 4, November—*Sky Study.*
No. 5, December—*Weather.*
No. 6, January—*Frogs, Toads, and Salamanders.*
No. 7, February—*School and Home Gardens.*
No. 8, March—*Trees.*
No. 9, April—*Birds.*
No. 10, May—*Snakes, Lizards, and Turtles.*

The program of publications for Volume II, 1935-1936, includes some emphasis on physical as well as natural science. The following numbers have either been published or will be published during the present school year:

No. 1, August—*Tide-Pool Animals.*
No. 2, September—*Man's Tools.*
No. 3, October—*Spiders.*
No. 4, November—*How the Energy of Nature Has Been Harnessed for Man's Use.*
No. 5, December—*How Living Things Get Food.*
No. 6, January—*Mushrooms and Other Fungi.*
No. 7, February—*Deserts.*
No. 8, March—*Wild Flower Roads to Learning.*
No. 9, April—*Ornamental Shrubs.*
No. 10, May—*Fresh Water Animals.*

2 "Suggested Course of Study in Science for Elementary Schools." State of California Department of Education Bulletin No. 13, Part I, July 1, 1932. Sacramento: State Department of Education.

A program of publications of the *Science Guides* has been planned definitely through the school year 1938-1939.[3] In 1936-1937, bulletins will be published on the following topics: shells and fossils; animals of circus and zoo; water, its use and conservation; communication; cone-bearing trees; earth and its neighbors; land forms; ferns, mosses, and lichens; small mammals; how living things get air. In 1937-1938, bulletins will be published on: orchard trees; how living things protect themselves; soil, its use and conservation; wood products; transportation; winter birds; field crops; chapparal; insect enemies and benefactors; rocks and minerals. In 1938-1939, bulletins will be published on: domestic mammals; bees, wasps, ants, and termites; native broad-leaf trees; large wild mammals; metals, their origin and use; seasons; streams and their valleys; domestic birds; how living things reproduce; state and national parks and forests.

A Coöperative Project with the State Colleges.

Members of the science department of each of the seven state colleges engaged in the preparation of teachers for the elementary school field have coöperated in the preparation of the bulletins.

These materials have been prepared primarily for the use of teachers, not children, and suggestions are made to help teachers adapt them to meet their local needs. They are not to be read to or used verbatim with pupils. The bulletins are useful more as a guide in the selection of activities and in the provision of reliable reference materials than as a dictated program which teachers shall follow. The state exhibits such a diversity of climatic and surface features, with their corresponding variations in flora and fauna that the bulletins are of necessity general in nature, with numerous suggestions for local adaptation.

Preliminary Experimental Use of Science Materials.

Plans are now being made for preliminary experimental use of the materials before the bulletins are published, in order (1) to test the interest of the material in classroom situations, and (2) to provide suggestions for teachers concerning activities which grow out of units of work in which the material is used.

Such an experimental use has just been completed preliminary to the publication of *Deserts.* Sixteen teachers of fourth, fifth, or sixth grades in the San Bernardino City Public Schools have used the material on *Deserts* prepared by Dr. Gayle B. Pickwell of San Jose State College in developing an integrated unit of work on this subject.

The children approached the unit in various ways in the different classes. Many of these children had lived on the desert and had interesting experiences to relate; some had interesting specimens and photographs; one teacher showed a reel of still films and another showed a set of colored slides to stimulate interest. Another teacher used poetry, such as Henry Van Dyke's *The Desert* and Bruce McDaniel's *Smoke Tree Trail,* to create a readiness for the unit of work.

Wide reading followed, to build a necessary background of information. Home, school, and community libra-

3 These "Guides" are available to science teachers outside of California at the price of $1.25 per volume of ten issues.—Editor.

ries were ransacked to locate the materials the scientist had listed as authentic in his bibliography. New words came to have meaning in an enlarging vocabulary, and words like *arroyo, habitat, osmosis,* and *resinous* rolled with ease off the tongues of ten and eleven-year-olds.

The deep interest all children have in collecting things was gratified by the opportunities afforded by the Desert Unit. A beautiful exhibit of minerals appeared in a show-case that one enthusiastic group purchased from a second-hand store. Non-metallic collections of lime, soda, potash, borax, were made. Plants, the interesting woods such as yucca, manzanita, insects, and desert photographs all provided materials for interesting first-hand experiences.

The highlight of the unit was an excursion by bus to Palm Springs, a hundred miles away! Preparation was made to help children anticipate what might be observed. A 16mm. moving picture film was made on the trip, to preserve in visual form the adventures of this thrilling experience. As a result of the school excursion many parents were motivated to take week-end trips to the desert and the children's "finds" on these occasions were enthusiastically received by their classmates.

The community manifested great interest in the study. Parents aided in other excursions to find the "unsuspected deserts" of the local environment. Citizens of San Bernardino arranged a desert exhibit to which group excursions were made. Local individuals who had some specific knowledge about the desert willingly coöperated. Some classes enjoyed as many as five or six professional speakers on such subjects as desert scenery (illustrated with the artist's oil paintings), Indian life on the desert, animal mounting, animals of the desert (illustrated with live specimens), minerals.

Beautiful maps of the deserts of the world and of California were made. A delightful map of "the unsuspected deserts" of California indicated the children's appreciation of the many regions where desert conditions prevail and result in a modification of plants and animal life. They were delighted to learn of the "rain shadows" which cause the semi-desert regions just to the east of the coast range mountains, and to discover why the ocean dunes which border the great Pacific—"the mother of all our rains"—are deserts.

Much beautiful art expression was stimulated. Exquisite arrangements of seed pods, gourds, flowers, cactus, and desert holly were made. Group friezes and individual pictures were made in calcimine, crayola, and chalk.

Music and poetry contributed richly to the experience and stimulated creative expression. The poems written by the children were many. A little Mexican boy in the fourth grade gave evidence of appreciation of a scientific fact of pollinization by no means widely known:

GOD'S CANDLES

Yucca, lonely in the desert!
  By yourself all day long!
Where no one touches you
  But the small white moth.
I can see you standing
  With your tall white blossoms
Pointing up to heaven
  Like the candles in our church.

—ANTONIO, 4B.

A class poem from a fifth grade group shows the appreciation of the children for the conquest of the desert by the sturdy pioneers:

COVERED WAGON DAYS

Covered wagons rolled across the sands
Their owners heading for the promised lands;
With death at their heels.

Lurking savages rode close to this band,
While scouts warned of danger at hand;
Riding past the wheels.

A fourth grade was inspired to creative music and poetry by the tarantula which visited them for awhile:

Fat, old spider, brown and furry,
You are never in a hurry
You walk so dignified and slow
Can't you remember where to go?

Much prose writing was motivated by the unit. Booklets were written about the excursion, letters of invitation and "thank you" letters were written to speakers. Letters were written to children in desert schools for information.

The unit was culminated with a play, *Desert Thanksgiving,* which summarized the rich experiences the children had and afforded opportunity for creative expression in art and dramatic form.

The coöperative effort in developing the teaching suggestions for this unit involved the entire school system. The supervisor of elementary education, the special supervisors of art and music, found opportunity to advance their progressive programs around the science interest.

It would be almost platitudinous to say that science is a fundamental interest with little children. The first gift they bring to teacher is probably a tightly clutched bouquet of bright colored flowers. A great pine cone, a delicately colored sea shell, pussy willows, insects, are all collected and treasured by children. They are shared with an understanding teacher.

Modern education impresses upon its students the importance of first-hand experience as a basis for learning. Could any experiences be more genuine to the child than those he has with the living, moving world about him? Greater utilization of these resources will indeed enlarge the child's vision and deepen his appreciation.

"Are science teachers 'informed persons'?"

Much experience in training teachers of science has convinced Dr. Ralph K. Watkins, on the staff of the School of Education, University of Missouri, that many gaps exist in the knowledge—both of facts and of methods—possessed by the "typical" science teacher. He makes practical recommendations.

WHAT SHOULD THE HIGH SCHOOL SCIENCE TEACHER KNOW?

RALPH K. WATKINS

THE obvious answer to the issue raised by the title of this paper is that the teacher must know the field of subject-matter which he is to teach, and how to present that matter attractively to young people. The problem is not quite so simple, however. The content of the sciences has developed enormously in our generation. In 45 years the high school population has increased between 1,600 and 1,700 per cent. This increase has carried with it a revolution in the purposes and ideals of secondary education. The science of today in many ways is not the science in which mature teachers were trained in their undergraduate days in college.

What must the science teacher in the present high school know in order to meet the demands of today? This paper is an attempt to present in a brief summary an answer to this question. It is based upon an experience of twenty years in directing the training of high school science teachers and a continued contact with many others engaged in the same enterprise. Concrete supporting data are introduced as they seem to fit. No pretense of an exhaustive review of statistical and experimental literature is made.

1. *The high school science teacher must know science as a general field.* No longer can a young college student specialize highly in a single branch of science and present the same facts and figures to high school pupils. Teachers must be prepared to teach all of the sciences offered in most high schools. Commonly, these are general science, general biology, physics and chemistry. Most teachers teach combinations of subjects, and there would seem to be obvious economy in being prepared to teach combinations of sciences rather than combinations of a science with subjects from other fields.

The inter-relationships of the sciences themselves have become more evident in the last fifteen years. To know the chemistry of today some physics must be had. The reverse is also true. What can be known of modern biology without a grounding in chemistry? To present any one science effectively the teacher must know something of the others.

2. *The high school science teacher should have some degree of specialization in one of the fields of science.* There should be some depth as well as breadth to training. This depth of scholarship seems best attained through a thorough grasp of one subject.

Better teachers who continue in the profession expect to continue beyond the training expressed by the bachelor's degree. Many science teachers in city systems have five years of training; some have the doctor's de-

gree. To continue training in science it is necessary to have enough work in one field to carry on in this field in a science department of a graduate school. Evidence of this can be had easily from a scrutiny of the catalogs of the universities.

3. *The high school science teacher needs the knowledge that has been developed in the field of professional education.* This includes a clarification of the objectives of secondary schools, a better understanding of the natures of pupils, improved techniques of instruction, a knowledge of better instruments of measurement for school products, and a better vision of the contributions of the several fields of human knowledge to the training of young people. The experienced teacher may find out parts of these things for himself by trial and error, and by observation. He can be greatly helped by systematic application of the materials worked out in the field of professional education.

4. *The well-trained science teacher must become acquainted with the professional literature of his craft.* There has developed a definite body of literature in science teaching. The volume of this is indicated by the two digests of investigations compiled by Francis D. Curtis,[1] by the report of the committee on a program for the teaching of science of the Thirty-first Yearbook of the National Society for the Study of Education,[2] by the annotations in G. W. Hunter's *Science Teaching,*[3] and by the material in such periodicals as *Science Education* and *School Science and Mathematics.*

5. *The high school science teacher should know the science textbooks developed for use in the secondary schools.* Changes in content of courses and in methods of organizing and presenting materials for pupils are made concrete and usable as they take form in the development of the newer textbooks. The teacher should have examined the available texts in order to make recommendation for a text to be used in his own classes. There are many useful teaching suggestions to be gleaned from a knowledge of other texts than the adopted one.

6. *The science teacher must have a working knowledge of the equipment needed for his work.* Often a science teacher is the sole authority in his school, sometimes in his whole community, who knows anything about science equipment. As knowledge of science and scientific applications develops, apparatus for carrying on scientific work is changed and improved. The teacher must become aware of possibilities of improved instruction that may be brought about with such new equipment. What can be done with micro-projection? What kinds of science phenomena can be best shown by means of motion pictures? These and other such questions continually confront the alert teacher.

7. *The successful science teacher must become acquainted with many of the familiar applications of the science which he teaches.* This is to be interpreted to include acquaintance with the physical entities through which science expresses itself in our daily lives. The teacher cannot teach biological principles to high school pupils and himself be unfamiliar with the names and forms of common plants, trees, birds, and animals.

The author has given identification tests to students in university classes in the teaching of science to find that on the average such students know a

third or fewer of the very common native trees, cultivated fruit trees, wayside weeds, cultivated ornamental flowers, and native rocks.

The contact of the high school learner, or of the ordinary layman, with science is made through those applications of science which touch his life, or arouse his curiosity. To teach science at all to these people the teacher must know home, street, wayside, and industrial applications of science.

8. *To continue a successful career, the teacher of science should keep up with the current literature of science.* This is especially important for that body of science literature which can be read by the high school pupil. The work of F. D. Curtis[4] has demonstrated the teaching value of science reading. The range of available materials is indicated by the *Science Book Lists* of the American Association for the Advancement of Science. Books for pupils are listed annually in the *High School Science Library* of H. A. Webb.

The extent of the knowledge of science books by teachers in training was tested by the author. Out of 60 books listed by Caldwell, Slossom, and Kellogg for the National Civic Federation,[5] students in a class of science teachers had read on the average fewer than three. This is indeed a poor showing for a "learned profession."

9. *Teachers of science must become familiar with the sources of accurate scientific information.* The facilities of the U. S. Government's many scientific bureaus, of the National Academy of Science, of large museums, and many organizations for the spread of scientific knowledge, should be understood and utilized. In an age when the layman is beset on every hand by pseudo-science and quackery, a large part of a teacher's training should consist of learning how to get reliable information.

Much of the information indicated here as needed by science teachers can be attained by undergraduate and graduate training in colleges and universities. Some of it can be developed through reading. Some is to be gained by continued observation, experience, and experimentation. Almost none of it can be mastered once for all and nothing further done about it. The teacher's knowledge must be a matter of continued professional growth which expands with maturity and experience, and makes continued contact with the human uses of his science materials and with the boys and girls of the schools. Only by this process can the science teacher hope to encompass a sufficient range of information to do effective work.

1. Curtis, F. D., "Investigations in the Teaching of Science." 1926. "A Second Digest of Investigations in the Teaching of Science." 1931. Blakistons.

2. National Society for the Study of Education, "A Program for the Teaching of Science." 31st Yearbook, Part I, 1932.

3. Hunter, G. W., "Science Teaching." 1934. American Book Co.

4. Curtis, F. D., "Some Values Derived from Extensive Reading in General Science," Teachers College, Columbia University. 1924.

5. National Civic Federation, "Bibliography of Scientific Books." 1929. (Out of print.)

6. Watkins, R. K., "An Analysis of the Types of Scientific Method Used by the Layman in Typical Out-of-School Situations." School Science and Mathematics. November, 1934.

"What science do they teach in the C. C. C.?"

In an article of model conciseness, Professor Carl G. Campbell, District Educational Adviser for the Charleston (West Virginia) District C. C. C., gives facts and figures, in which countless human interest stories are unquestionably hidden. This gives us an idea, however, how the C. C. C. boys are "taking it."

SCIENCE EDUCATION IN THE C. C. C.

CARL G. CAMPBELL

IN May, 1934, I was one of several Educational Advisers assigned to camps in West Virginia. There were no instructions; there were no curricula; there were no students or teachers; there was only a C. C. C. camp of 200 boys. An Army officer saw to it that the boys were housed, clothed, fed, disciplined, and paid. A Technical man saw to it that the boys did a day's work of eight hours at least five days a week, if the weather permitted outside work. An Educational Adviser was supposed to minister to the mental requirements of the enrollees, but nobody knew how that should or could be done.

One of the enrollees was assigned as assistant to the educational adviser. This enrollee was supposed to do whatever the adviser wanted him to do. He had a personal knowledge of nearly every boy in camp, so the adviser asked him to bring a few of the natural leaders together for an informal conference. These boys were sturdy chaps, looked the adviser right in the eye, and seemed to possess a lot of initiative. Not a single one of these boys wanted to study science, it appeared; what they wanted was baseball. They had a baseball team organized, but they wanted to *study* baseball. So we studied baseball. The next afternoon we rode nine miles by truck to a field where we put into practice the principles we had studied the night before. It became very evident that these boys had a reason for wanting to study baseball. A rival camp team had given them a drubbing recently, and they were determined to return the compliment. A motive! Without a motive, there has not been a successful course of study introduced into the C.C.C.

Nature Study seemed to be a logical course for a group of C.C.C. enrollees, but they did not seem to be much interested in it. Then we announced Forestry would be taught by experienced woodsmen. For this course 25 enrollees appeared at the appointed time, organized a Forestry Club, elected a leader, and invited National Forester Medesy to teach them. Each member of the Technical Service appeared before this club, telling the members those things he knew best, answering many questions, and stimulating much discussion. These members wanted to become qualified woodsmen, eligible for appointment as foremen, fire patrolmen, game wardens, and any other work at which they might make a living.

From such a beginning, hundreds of courses have been organized in C.C.C. camps, all motivated from the vocational or the academic point of view. Those who believed that a certain course would definitely prepare them to earn a living enrolled in that course and studied it just so long as it

continued to appeal to them from that point of view. Those who saw an opportunity to remove a certain scholastic deficiency, or to obtain better preparation in a subject which might be taken in regular school later, enrolled in a course designed for the students who wanted it for such purposes.

Where did we get the teachers? They came from all possible sources. During October, 1935, 23,906 teachers taught 40,350 organized courses to 601,959 C.C.C. enrollees throughout the nation. Of the teachers, 2,027 were educational advisers, 1,916 were assistant educational advisers (enrollees), 3,975 were military officers, 6,617 were technical service men, 5,830 were enrollees (not assistant educational advisers), 1,321 were Emergency Education Program teachers, 903 were regular school teachers, and 1,317 were unclassified. Besides all this, 188,783 enrollees received systematic instruction on the work job, of a sort calculated to make semiskilled workers out of untrained boys. There were also 11,283 illiterates, of whom 9,078 learned to read newspapers and write letters.

How many of our courses may properly be called "science courses"? If we accept the dictionary definition of science, nearly all of them might be so classified. To be specific on this point, however, here are the titles of courses now being taught that are generally considered as scientific: anthropoloy, archeology, astronomy, bacteriology, biology, botany, chemistry, entomology, geology, meteorology, philosophy, physics, physiography, physiology, political science, psychology, topography, and zoology. Add to these civics, economics, geography, history, occupations, and sociology, and you have the "academic" list.

Then we have some science classes that are distinctly "vocational" in their purpose and content. Agriculture, air conditioning, auto mechanics, aviation, blacksmithing, blasting, blue printing, butchery, concreting, conservation, cooking and baking, electricity, engineering, engines (gasoline and Diesel), finger printing, forestry, road grading, decorating (interior), jackhammer, landscaping, lathe work, leather tanning, map making, masonry, mechanics (all kinds), mess management, mining, motion pictures, painting, plastering, plumbing, printing, quarrying, radio, saw mill operation, shoe repair, sign painting, silversmithing, soil conservation, steam (theory and applications), steel construction, stone and marble cutting, surveying, taxidermy, telegraphy, telephony, tinsmithing, tool and die making, tractor operation, truck driving, welding, and wild life conservation. Even this, however, is not the complete list.

The enrollees are learning to construct bridges, buildings, dams, fences, guard rails, levees, power lines, sewage disposal systems, telephone lines, water supply systems, airplane landing fields, roads and trails, erosion control systems, flood control systems, forests of the perpetuating types, recreational systems, ranges for stock and wild life, and many other things that the average boy knows little about.

They learn social customs, dancing, music, cards, life saving, physical culture, personal and community hygiene, and how to live together congenially. The boy who refuses to learn these things "goes into the river or over the hill."

"How can I make them behave?"

Fellow teachers were heard to say, "Miss Elizabeth certainly knows how to keep order!" so we followed the lead and asked her to tell how this most important aspect of science teaching is carried out. After reading her article, we would like to be a Bad Boy for a period in her classroom at the High School, Rock Hill, South Carolina.

DISCIPLINE IN THE SCIENCE CLASSROOM AND LABORATORY

ELIZABETH SEGARS

SCHOOL management and discipline are no longer looked upon as rules to prevent breaches of discipline, but rather as earnest attempts so to condition the children while in school that they will realize that schools and teaching are devised for them and *not* for teachers. School government has come to be a matter of moral training and social coöperation.

The functions of discipline are threefold: (1) creation and preservation of an orderly working condition; (2) preparation of the pupil for worthwhile participation in an organized adult society; (3) development of the important art of self-control.

With the word discipline defined and its functions outlined the question which remains unanswered is: How shall a well-disciplined room (science classroom and laboratory, in particular) be maintained?

But before we go further into the matter, let us ask (and answer, if we may) this question: What part has the teacher in this necessary work? The teacher is in the schoolroom primarily for indirect rather than direct purposes—she is there to utilize self-expression on the child's part, and to redirect the child's activity so as to transmit present interests into future interests. *What a task this may prove to be!*

More than that—she has not just *a child,* but a room full of children with whom to deal. And each must be dealt with separately, because in that one room is found the stubborn pupil, the haughty pupil, the irresponsible pupil, the morose pupil, the "touchy" pupil, the deceitful pupil, the vicious pupil—each with his own particular interests—*because* each is living his own life.

For a working condition to exist, *order must be maintained!* Yet this may be done better through reverence and regard for the teacher than through fear. Someone has said, "Love only is the price of love. If you wish your scholars to love you, you must first love them—really and truly love them."

For the children to reciprocate their love for yours there are many things you must do. First of all, consider your scholars as reasonable and intelligent beings—and what's more, treat them as such! Explain to them *why* you consider one thing right and another wrong, and they should understand. Take a child's reasons into consideration. After all, they are not so bad—*to him.* Lead the leaders by having them feel that you are a real friend—one on whom they may depend. Show them kindnesses and courtesies, assuring them all the while that they are more than mere children.

By all means be sympathetic. You can remember when you were in their places, can you not? Prove that you can by avoiding harshness and sarcasm. They do not relish that spirit any more than do you and I. Gain their respect by being firm, yet fair, with them. Assure them that each piece of work has value and give them credit for it. Be as fair as you possibly can in grading them and also in administering punishment. Never cater to any one child for political or any other reason. No reason, regardless of how good it is, is an excuse for pets. A teacher who is fair and square in every detail is placed upon a pedestal by those with whom she deals—yes, she is fairly worshipped by some.

With love, respect and confidence, a teacher's task in gaining a child's interest in his work is largely accomplished. Present your problems to the child—for *his* solution. Soon *his* confidence in you will inspire him to present *his* problems. Regardless of how insignificant they may be, give them consideration. Suddenly his ideas have gained importance. What a wonderful person you are to him! Then you have your well-disciplined room!

No subject in the entire curriculum do we find more valuable than science as a means of moral control. Its service in character-building is that, like life itself, it deals with realities. The rocks and shells tell the truth as it is. There is greater morality in the study of magnets than in the distinction between "shall" and "will"; more virtue in the knowledge of birds and flowers than in the details of a battle some thousand years ago. The essence of character-building lies in action—and where is there more action than in the science laboratory? In my opinion, action in the science classroom and laboratory is unsurpassed.

With this splendid opportunity to guide these boys and girls, teachers should strive to "make work the master" by requiring accurate, neat and complete work. These qualities increase a student's interest because of that pride which accompanies efficiency.

Surely if these conditions exist, the opportunities for stimulating the pupil to climb to higher planes are numerous. The child will induce from his own struggles and triumphs the all-important lessons of persistence and patience. To me it seems that at this point discipline, in its broadest sense of the term, becomes an effective agency for growth in mental power and ability, rather than the age-old problem of chastisement and punishment.

If certain of my readers shall charge me with indefiniteness and lack of concrete advice in this vital matter of discipline in the classroom and laboratory, I must answer that greater detail might be a poor prescription for a teacher who is in trouble. The same philosophy has been expressed by that noted instructor, William Chandler Bagley, in his assertion that "The form or the letter counts for little; the spirit or the attitude is all-important." He merely paraphased a great Apostle, who knew the hearts of men, and wrote that our sufficiency as able ministers is "not of the letter, but of the spirit; for the letter killeth, but the spirit giveth life." (II Corinthians 3:6.)

"How can a biologist render public service?"

Read the first paragraph in this article by "Cap'n Bill," veteran Professor of Nature Education at Western Reserve University, Cleveland, Ohio, now on leave for a service to the National Recreation Association. It introduces a pioneer in "nature guiding," an expert in camping tours, an inspiring personality to an army of his students and readers of his books.

NATURE EDUCATION: SOCIAL AND RECREATIONAL

WILLIAM GOULD VINAL

I HAVE never exactly considered myself a cloistered biologist. My nature leadership experience has enabled me to contribute to two Y. M. C. A. boards, a scout board, and a board of executives of a well-known community center. My students have run nature clubs for branch libraries and social settlement houses. Last summer twenty-six of them were nature counsellors in organization camps. Such inclinations may have been some of the reasons for the National Recreation Association inviting me to present nature recreation at their institutes in various cities during the present school year. The experience has been most enriching to me and has presented some challenging problems. The solution of many of society's perplexing needs, perhaps baffling social ills, have their roots in biology. I am glad of this opportunity to bring such vital experiences to the foreground for consideration by those who are training leaders in nature education.

Can the average college student pick up the loose ends of his experiences in comparative anatomy, in histology, in bacteriology, and perhaps in physiological chemistry and utilize them in the solution of present-day problems? Can he take his present knowledge of trees, birds and flowers, and put it to work on the T. V. A., or juvenile delinquency, or the leisure day, or on city parks, or CCC or WPA recreation programs? One definition of education is, "To prevent a man from being humbugged by the newspapers." After weighing evidence in the science "lab," can the student weigh political propaganda poured upon his eyes and ears relative to conservation and hunting? Is he aware that clean streams, game fish, fur bearers, song birds, vistas, the wilderness—like timber itself—are forest products and hence public utilities? What is his attitude toward and appreciation of city parks, public camping grounds for autoists, outdoor stoves, nature trails, or wilderness areas for hikers? Does the city with 30-foot lots as compared with 60-foot lots, one-acre subsistence areas, fenceless gardens, biology laboratories lighted at night (as well as gyms and music rooms), and auto caravan trips have any implications to him?

To learn that scientific experiments need planning, and then to right-about face and adopt a *laissez faire* policy with humans is inconsistent. What the masses need is applied biology in the laundry, in the backyard, in camp, and in the metropolitan parks where life is lived. They need to know the window-box, the playground, and the forests as points of refuge in times of poverty and unemployment. They must be taught how streams and soil can be made productive and pleasur-

able. They must be given that biological philosophy that enables them to visualize things, time, space, and progress in the large.

To change is a natural law. It applies to everything. We are continually obtaining new hair, fingernails, skin, and cells. Depressions, governments, hobbies, wars, mailed fists, utilization of wastes, and education are also subject to change. With a changed world there must come a change in biological education.

The law of adaptation is the price of change. The mastodon did not adapt himself to a change and he only exists in museums. Let the thermometer change ten degrees on the average and there will be many who cannot survive. Bring on a new kind of depression (according to natural law it would have to be new) and a certain number of people will be physically or professionally exterminated. Abandon the subject-centered curriculum and many leaders cannot adapt themselves. They may just as well be placed alongside the mastodon. How can such a person step outside of himself and view the situation?

Social-recreational biology is already coming into its own. In Cincinnati there is a blighted district that has one-fortieth of the population. But it has one-twentieth of the crime and one-twentieth of the deaths from social diseases and tuberculosis. Recently there has been a slum-clearance project which has opened up a twelve-acre plot—an area larger than all the rest of Cincinnati's playgrounds combined. The cellar-holes have been filled and top soil brought in. The Director of Recreation combed the country to obtain a leader capable of using the twelve acres to wipe out crime and disease. Such a potential leader was discovered on the Pacific coast. She has started to whip the problem—what William James might call the "moral equivalent of war"—by having the folks of the district grow flowers.

Social re-creation through nature applies equally well to the rural areas. Fifty miles out of Detroit, in what is known as the Hartland Areas, a business man has fifty projects under way for restoring the morale of folks who were sitting on the verandas waiting for something to happen which never happened. It is his contribution to his birthplace. On the farm are raised pure-bred Shropshire sheep. These are given to country boys and girls, who, in turn, give back a part of the offspring that more boys and girls may have a similar opportunity. Is this recreation or education? Is it play or is it work? Is it social science or biological science? The important thing is that it is a situation out of which come experiencing and enjoying rather than memorizing and reciting.

Perhaps the best guide to a nature recreation program is the nature hobby. Nature hobbies are present in every community. Most of us do not recognize them as nature recreation. A motorman raises canaries—but not for sale. A physician grows alpine flowers in his backyard. A nurse escapes the sordid side of life by raising tropical fish. Three business men on our street have rock gardens. The P. T. A. is having a series of lectures and demonstrations on flower arrangement. Japanese dish gardens are all-the-go in the department stores. Amongst my friends are iris growers, pigeon fanciers, dyed-in-the-wool fishermen, "glad" specialists, and backyard

bee keepers. Each of these nature hobbyists stands the test of the objectives of education. Each is carrying on in spite of teachers and recreation leaders. What would have happened if such channels of interest could have been opened up to the hundreds of others with nothing to do?

If nature hobbies were to be eliminated from any big city there would be suffering. It would make a difference to that city. At the Toledo Boys' Club I recently saw a handcraft person who had a roomful of newsboys doing twelve different projects. Leaders are needed who can present a three-ring offering of nature hobbies. The work of making aquaria out of junk-yard auto-windshields and of raising tropical fish therein may make a happy, self-respecting naturalist out of a discarded steel-worker. Reconditioned steel-workers go out into the world again just as do resuscitated goldfish or impoverished seedlings with sunshine turned on them. The potential re-creation value of nature as demonstrated by nature hobbyists in every community, and its reclamation value for folks discarded by the depression, is too great to be overlooked by nature educators in these trying times. People are starving for nature. If we have the vision for training leaders we can yet reclaim many of the down-and-outs, and—what is perhaps more significant—we can guarantee that no more shall these folks sit and wait for something to happen.

In closing, let it be said that the technical biologist need not look upon recreational nature activities with either alarm or disdain. Even the running of science sketches in the motion pictures may have a place, and there are those who may be won to the interest of science from the amusement plane. We can bring possibilities upon the stage, but the individual must make his own hobby choice in terms of what gives him a real thrill and enjoyment, whether it be the kinds of bait or the conservation of fish. Leisure time pursuits may extend beyond the level with which the interest started. The laboratory is not as important as the subject, the subject is not as important as the leader, and the leader is not as important as citizens and the public mind. Science is a legitimate free-time activity and has a place in social changes and adjustments which in the end widens appreciations, attitudes, and knowledge.

"Is it proper to have fun in the science class?"

For more than a score of years we have noticed the descriptions of new apparatus, novel improvements, and clever adaptations for science instruction published here and there by Prof. Guy M. Lisk of the Science Department, Northwestern State Teachers College, Alva, Oklahoma. In the article he sends us at our request, we discover that he believes the head should be as clever as the hands!

THE RESOURCEFUL SCIENCE TEACHER

GUY M. LISK

THE author is an instructor in a state teachers college, the excuse for the institution's existence being that presumably it is possible to train teachers as a medical school trains doctors, or a technical school trains engineers. In the selection of experiments in science, therefore, and in their method of presentation, the question in the foreground is: Will this help the student to "put it over" when he gets that specific job "down to Podunk," or wherever the Fates decree he shall face future citizens in the classroom?

Furthermore, the handicaps of a teacher as regards equipment, often pitifully meager, have been kept in mind. The "resourceful science teacher" is one who can use what material he may have at hand, even though it be limited in quality and quantity.

Let us take the common kerosene lamp, and list a few of the questions that might be based on it. Just what makes it give light? Does the same answer hold true for an electric light; a gas-mantle lamp; a neon sign?

Explain appearance and disappearance of film on cold chimney of newly-lighted lamp?

What is the purpose of the oil, the wick, the cap, and the chimney?

Does the wick burn?

Effect on flame of placing another chimney on top of the regular chimney?

Why can a recently burning lamp be more easily lighted than a cold lamp?

What gases are entering the chimney of a lighted lamp, and what gases are leaving? Are the amounts the same, and why?

Explain eight ways (there may be more) in which a lamp may be made to smoke.

Yes, we'll acknowledge that the kerosene lamp is somewhat out-of-date, and the answers to the above questions may be of no practical value, yet we do claim that, properly conducted, such an exercise will interest the student and persuade him to *think*. While we are at it, however, let us impress on the class the important truth that many of the commonly accepted "every-day facts" are only partial facts, and that the true scientist learns to avoid a too "bumptious" air of certainty about anything. Rather, he is ever tolerant of the voice crying in the wilderness—"Who really knows?"

So here we are; on the day previously the lamp has "talked," and we are ready to ask the "bright boy" of the class a simple review question: "What happens when a lighted lamp is turned up beyond a certain point?"

"Why, it smokes," he answers. But does it? The lamp is given a quick upward turn, stopping the wick just above the cap. (A teacher should practice this beforehand until he fails not.) Lo, the lamp continues to burn without smoking, though much of the wick is exposed. "Why doesn't the flame crawl down the exposed wick?" True, Teacher knows—perhaps!—but this is a nut for Johnny and Susie to crack.

Having finally explained this, we play a return engagement. We have the question settled as to what the lamp may do when turned up, depending on the method followed. Again we turn it up quickly, this time stopping the wick just below the cap, and out goes our lamp. Now that was aggravating, for the question was *not* settled, and we must wake up and think again!

Let us again caution the teacher to practice and practice until he and his lamp are on very friendly terms. An experiment that flops adds nothing to the performer's good opinion of himself, but may prove a source of mirth to his class. (Aren't kids the limit, anyhow?)

Well, we'll let the old lamp have a rest, though we must some day show how to put out the lamp with two little sticks without touching the lamp. (Two lighted matches are held under the burner, one at each edge of the flame.)

And one more question, and there we'll "blow out the lamp for sure." What would be the effect on the flame if the air were to change to pure oxygen? This can be easily answered by admitting pure oxygen underneath the burner. Most students will fail to answer this question correctly ahead of time.

An important factor to be considered in any demonstration is the method of presentation. We have all seen the street fakir sell his wares, not so much because of the value of the goods, but rather because of the line of verbal "patter" or "hokum" which he freely dispenses. Could not the "resourceful science teacher" profit by his example and so better sell himself and his "goods"?

May we illustrate with the good old scientific trick, Water Into Wine. It is Monday, the proverbial blue Monday. The teacher stands before his class, four apparently empty tumblers at hand. (No. 1 contains a few drops of Sodium Hydroxide; No. 2, a few drops of Phenolphthalein; No. 3, Sulphuric Acid; and No. 4, Bismuth Chloride.)

Now for the "patter":

"Well, pupils, this is Monday, so let's drink a health to a pleasant, profitable week." (No. 1 is filled with water.) "Ah, me, though, a real toast should be drunk with wine, and this is only water. But wait! Why not try a little scientific wishing? Here goes: 'Hocus pocus, water into wine!'" (No. 1 is poured into No. 2, turning into "wine.") "There it is, rich, red, sparkling wine! But alas! I'm afraid to drink it, for what would the old folks at home say—'Your teacher drinking wine, and right before his class?' I must get rid of it, so no trace will be left. Ah, I have it! Let's try some backward wishing. Instead of 'Hocus pocus' we'll try 'Pocus hocus!' Here goes again: 'Pocus hocus, wine into water!'" (No. 2 is poured into No. 3, turning clear.) "I want to say, pupils, I was glad to

get out of that scrape so easily."

"Perhaps, though, there is one of you, not so squeamish as I, who might want to try his hand on scientific wishing. How about you, John?" (John should be the "class nuisance"; there's always at least one in every class to make "Teacher," at times, sorry it ever happened.) "Simply say, 'Hocus pocus, water into wine!'" (John responds, as No. 3 is poured into No. 4, turning to "milk" instead of "wine.") "Pshaw! milk instead of wine! But I've always found it works that way when the one who makes the wish hasn't been weaned yet." [1]

The reader may think this ending a little tough on John, but it's the idea of "patter" we are trying to put over, and we really have no desire to hurt John's feelings—at least, not much.

Newspaper writers are prone to play up the sensational features of any new discovery, oftentimes permitting their imagination too full play. Periodically there comes an article on the "Death Ray," an invisible something akin to the radio waves, but supposed to be capable of destroying life or exploding ammunition at a distance of many miles. The possible results in the next war are vividly painted, the gentle reader has a nice shudder, then the matter is cast aside as wholly improbable.

But is it really so very improbable? "Tomorrow, dear children, you'll be shown a 'Death Ray' capable of causing an explosion at a distance of not a few miles, but at a distance of millions of miles."

Comes tomorrow, and there is collected over water a bottle filled with equal parts of hydrogen and chlorine, the apparatus being kept out of the direct sunshine the bottle is corked and brought to the window; when the direct sunshine, our "Death Ray," strikes the bottle, an explosion occurs, blowing the cork across the room. A burning magnesium ribbon will also do the job.

Since all explosions are merely certain types of chemical changes, why may not the day come when an ether wave will be discovered which will do for TNT what the light waves did for the gas-filled bottle? One thing certain, dear teacher, your class will wake up when the "Death Ray" hits.

It is perhaps needless to say that back of every experiment there should lurk some scientific fact which should be driven home before the pupil's interest wanes. What we wish to make clear is that the intellectual food set before a class must be something they can digest and must be served in a way that will appeal to their mental appetites.

The resourceful science teacher should be ever on the outlook for new experiments, or new and better ways of presenting the old ones. A careful perusal of the current issues of magazines devoted to scientific topics will mean the constant addition of worthwhile demonstrations to the teacher's list of "eye-openers," without which the teaching of science will lose much of its possible educational value.

1 [The reference, of course, is to a big, bawling calf at its most awkward, undisciplined stage. These Oklahoma citizens are close to nature, and their analogies are characteristically frank.—Editor.]

"How might I study abroad?"

Ambitious science teachers may obtain the first suggestions from this article, written by Dr. Lois Meier Shoemaker, Assistant Professor of Science, State Teachers College, Trenton, New Jersey. We regret that interesting photographs of the "walking tour" which she conducts each summer could not be reproduced.

OPPORTUNITIES FOR SCIENCE STUDY ABROAD

Lois Meier Shoemaker

A EUROPEAN sojourn planned for study has a purposefulness productive of much satisfaction, not only in the enrichment of professional background but in the enjoyment derived from travel.

A student should first consult a reliable educational authority on foreign education before making definite plans for study abroad. Two such authorities are the Institute of International Education at 2 West 45th Street, New York, and the International Institute of Teachers College, Columbia University, New York.

There are three courses open to a student who wishes to study abroad: (1) he may enroll at a foreign university and may even eventually earn a degree from that institution; (2) he may study at a foreign university or do research in a foreign country but arrange to receive credit at an American university; (3) he may enroll as a member of a foreign field course from an American university, for which university credit is given.

Germany has long been popular for the study of science and science education. The author herself has had experience in Germany, and will therefore make frequent reference to that country. If a student chooses the first or second course, that of study at a German university, he should take abroad with him at least a bachelor of arts degree or evidence of graduation from a professional school of recognized standing. The German secondary school carries a student through the equivalent of the sophomore year in an American college of recognized standing. An American high school graduate would not be permitted to attend lectures in a German university, for he would not possess proper academic credentials. Certain American colleges have arranged for a year of supervised study abroad, particularly in France, for junior students, under the so-called Delaware Foreign Study Plan. This year, however, is intended not for science students, but for those interested in France and the French language. Foreign study is also provided for in the curriculum of New College of Teachers College, Columbia University. The amount and place of science study would undoubtedly depend upon the special interests of the individual student.

A proficiency in the German language is required for matriculation in a German university. If evidence of this proficiency cannot be presented the American student is obliged to attend one or more sessions of a school such as the German Institute for Foreigners at the University of Berlin, until he obtains a certificate attesting proficiency in the language.

In a German university there are two sessions a year, the spring and winter sessions, beginning in May and

October and ending in July and February. There are long vacations in between, which the student often uses for reading, writing, and research in the field of his particular interest, since the schedule of a student during the semesters is heavily loaded with lecture hours. The science departments of universities utilize part of these periods to conduct field trips in biology and geology for their students.

Such summer courses as are listed at various universities—as in the bulletin *Ferien-Kurse in Deutschland*—are not counted towards a degree in a university and are meant for foreigners. These courses are intended mainly to promote efficiency in the language and to orientate the student in the country, its customs, history, economics, art, music, philosophy. Such science courses as are listed are of a few days duration only, and are intended to acquaint persons already in the professions with latest developments and practice in the separate fields. As an example is cited the course in Hydrobiology, given July 15-20, 1935, at Kloster auf Hiddensee on the Baltic coast.

The American system of degrees does not exist at a foreign university; even in England degrees of the same name have entirely different meaning. If an American holding a bachelor of arts or a master of arts degree wishes to stay more than one year at a foreign university and specialize in science, with success the degree which he would bring home would be Doctor of Science. On the continent this involves the writing of a dissertation in a foreign language.

Many students prefer to make arrangements for foreign study and research to count towards a degree in an American institution. To quote again from personal experience, study over a period of fourteen months by the author, including visitation of schools throughout Germany, was accepted as part of the required work for the doctorate at Teachers College, Columbia University. The material collected during the visitation of schools was used for the dissertation under the title, *Natural Science Education in the German Elementary Schools.* A similar research study in foreign science education was made by H. F. Kilander of Upsala College, East Orange, New Jersey, who spent several months in Sweden. This study,entitled *Science Education in the Secondary Schools of Sweden,* was likewise accepted for the doctorate at Teachers College. At the present writing Alexander Efron, Chairman of the Science Department at the John Adams High School, New York City, has just returned from abroad, where he has been carrying on research on the teaching of the physical sciences in Paris, Moscow and Leningrad, in part fulfillment for the doctorate at Teachers College. For such independent research fluency in the language of the countries concerned, namely German, Swedish, French and Russian, was necessary.

The actual expenses of courses and living at a foreign university are usually less than in an American, but the addition of travel and holiday expenses raises the total cost for the year considerably. A number of fellowships are available for foreign study. Complete information regarding fellowships is printed in a bulletin of the Institute of International Education. The author was fortunate in securing an exchange fellowship of the American German Student Exchange which

provided free tuition at the university at Frankfort am Main and money for board and room in a private family for two semesters. Six weeks of the first summer were spent at the summer session of the German Institute for Foreigners in Berlin, and the vacation periods during the year were spent in intensive visiting of science classes in all kinds of elementary and secondary schools and teachers colleges in all parts of Germany.

The third road to foreign study is the field course in Europe and European education offered by American universities. Teachers College of Columbia University under the direction of the International Institute of Teachers College in coöperation with various national education authorities offers annually a number of such field courses, for which four to eight points of university credits are available.

In the summers of 1931 and 1932 a six-weeks field course in science and science education in Germany was led by the author under the above auspices. Earth forms and plant and animal life of Germany were studied at first-hand on walking tours through North Germany, the Eifel, the Rhine region, the Black Forest, the Bavarian Alps, and Saxon Switzerland. Museums, such as the German Museum in Munich and the Hygiene Museum in Dresden, planetaria, school gardens, and other educational agencies were visited. Opportunities for learning to know the German people, their language and their customs in both city and country were ample. Six points of graduate credit were given for the successful completion of the course.

Plans are in prospect for similar field work in the northern Mediterranean region. In such a study emphasis will be centered upon the effects of meteorological and geological features of the environment on the history of civilization in these regions. There will be no language requirement for this course.

The Field Course in Education in Germany, the Field Course in Education in England, and the Berlin Residence Study Group, as offered in 1935 by the same Teachers College, provide for studying science education in the schools of Germany and England under competent direction. There are no language requirements, although the courses are most profitable if one knows the language. Pointers with regard to the techniques of school visiting in the various countries, the organization and the educational philosophies of the school systems, the vacation periods which are widely different from the American, the daily schedules, the obtaining of necessary visiting permits, are provided by experienced leaders. Affiliation with a group of students having a common purpose provides a definite stimulus which makes such study very worth while.

"Who said, 'One picture is worth a thousand words'?"

A representative of the manufacturers of widely-used visual materials was asked to give his point of view. We discover that Mr. Stackhouse is much more than just "an agent"—he is a tireless, tactful "teacher," and helpful though unofficial "inspector" throughout a large and cultured region in North and South Carolina.

WHY VISUAL MATERIALS APPEAL IN SCIENCE

J. M. Stackhouse

As a representative of two commercial manufacturers[1] of visual materials, the writer has had the opportunity to observe at first-hand varied uses of such materials by public school and college science teachers. A salesman gets reactions from science teachers both for and against each of such visual aids as lantern slides, stereographs, and motion pictures. He visits some science departments where visual materials are used consistently and effectively; others, where they are used poorly, or not at all. Inevitably the salesman makes comparative observations. From a variety of such observations the writer hopes to suggest at least a few of the practical considerations involved in the use of visual materials by science teachers.

Lantern slides and motion pictures may be projected for large as well as small groups of students. Furthermore, the cost of such materials is much less, comparatively, than the cost of extensive laboratory apparatus, or supplies for individual students. It would therefore seem reasonable to expect to find science teachers in those schools with only a minimum of laboratory equipment and only a minimum if not entirely vanished appropriation for supplies, using visual aids in lieu of the apparatus which they are unable to buy. Nevertheless, the exact contrary is usually the case, and while no generalization covers all situations, it is usually true that only in those schools having extensive laboratory equipment will one also find the science teachers using varied visual aids. Thus we see that the actual situation is often the reverse of what would seem logical. Certainly this aspect is worthy of consideration by administrators in those schools with limited budgets.

As an illustration of how visual aids might be practical under certain typical conditions, probably no better example could be found than in slide 67 of the Keystone General Science Unit on Health.[2] On this slide are 17 excellent reproductions of microscopic photographs of plant and animal life. A single microscopic slide of any of these specimens would cost at least 50 cents. This lantern slide, priced at 50 cents, therefore contains the equivalent of $8.50 worth of microscopic slides. Furthermore, when the slide is projected upon the screen it may be viewed simultaneously by every member of the group, whether there be ten or fifty. By questioning the students and pointing to the pictures the teacher may be definitely sure that the students actually see those aspects of the specimens which it is desired that they should see. Of course, no one can contend that a microscopic photo-

1 Keystone View Co., Meadville, Pa.; Bell & Howell Co., Chicago, Ill.
2 Webb's Units in General Science. Keystone View Co., Meadville, Pa.

graph is as valuable a piece of equipment as the actual specimen viewed through a high-power microscope, but assuming a class of twenty or more students and one low-power microscope, lantern slides similar to the above would unquestionably be of practical value to the biology teacher.

Slide 97 from the Keystone Unit on Light is an excellent illustration of how a projected picture may be used, where the actual apparatus is not available, to teach a difficult principle involving the use of complicated mechanism and processes. On this slide is a photographic picture of the interior mechanism in a modern sound-on-film projector. This slide shows the source of illumination, the sprockets, and film threaded through the machine, the projection aperture, condensing and objective lenses, the sound head with its alignment of exciter lamp, optical lens, sound gate, and photo-electric cell. On one side of the slide is an enlarged section of film showing the arrangement of the sound track. The writer has frequently used this slide to teach a class of high school pupils, and we occasionally suspect to teach the teacher also, how sound motion pictures are reproduced in the modern motion picture machine. It is interesting to observe that despite the technical nature of the explanations involved, high school pupils invariably show intense interest in a presentation of this sort. On many occasions we have followed such a presentation by actually showing the projector itself, and questioning the pupils as to its mechanism and operation. It is certainly surprising how quickly they absorb the correct information.

The above examples are of course merely illustrations of how a visual aid may be used to supply a deficiency in equipment. Such instances, using not only slides but also stereographs and motion pictures, might be multiplied many times over in each of the usual high school science courses. The teacher of high school general science alone, covering such diverse subjects as electricity, light, sound, astronomy, water, air, and machinery is indeed fortunate if he has even a little apparatus in each of these subjects to use for demonstration purposes, not to mention the greater improbability of having adequate apparatus with which individual pupils may experiment. Certainly it is true that the average science teacher will find visual materials to be a valuable supplement to whatever he may have in the way of physical equipment, and will find that by the use of such aids he has tremendously increased the learning possibilities of the students.

Considerations such as the above have led to two experimental studies with the Keystone General Science Units in the territory covered by the writer. The first of these studies was made, at the request of Dr. J. H. Highsmith, State High School Director in North Carolina, in the High Point High School, under the supervision of Principal L. R. Johnston. The second experiment was made in the Wardlaw Junior High School of Columbia, S. C., under the supervision of Principal D. L. McCormac. Both studies covered a period of two full semesters.

Space within this article does not permit details as to the organization, procedures, and results of these two studies. It may be stated here, however, that each of the teachers involved in the experiments reported in

their conclusions that there was a marked increase in the interest factor, and that the units had definite value as supplementary materials. The results of the experiment in the Wardlaw Junior High School were not as favorable to the slide units as the results in the High Point High School, but it was felt that this was offset to some extent by the fact that in the Wardlaw School no textbooks were used by the pupils in the experimental groups. In the High Point study it was found that although both the high and the low experimental groups surpassed the corresponding control groups in achievement scores, the slides seemed to be of greatest help to the low, or slow moving groups.

It may also be stated here that Dr. Highsmith, in requesting that this study be made in the High Point High School, had in mind the fact that appropriations for schools had been radically reduced, the teacher load sharply increased, and that science teachers in the smaller high schools were severely handicapped by lack of equipment. Under prevailing conditions the small high schools were finding it almost impossible to meet the minimum equipment requirements for standardization. The High Point High School was selected because it had comparatively extensive laboratory equipment, thus permitting the control groups access to adequate laboratory materials, whereas the experimental groups used only the lantern slide units, supplemented by hand-made slides and a minimum of demonstrations by the teachers. Both groups used the state adopted texts. It was desired to ascertain whether the Keystone General Science Units might function satisfactorily in lieu of certain required and more expensive apparatus. The results of this study indicated that this might be done satisfactorily, and the high schools of North Carolina are now permitted, if they so desire, to meet certain minimum equipment requirements by the purchase of a stereopticon and the Keystone Science Units. Inasmuch as several of the units are useful in more than one field of high school science, as for example the use of the animal, plant, and health units in both General Science and Biology, and the use of the electricity, light, sound, air, and machinery units in both physics and general science, there is a duplicate value in the slides for the small high school.

No comparative analysis of the relative values of lantern slides and stereographs, as compared with silent and sound motion pictures may be attempted here. It is fairly safe to state that at the present time the most widely used visual aid in science, and perhaps the most practical, is the stereopticon with the prepared, or hand-made lantern slide. The etched glass slide, upon which drawings and schematic diagrams may be easily made with an ordinary pencil, is particularly economical and practical. The drawings upon such slides may be erased and the slide used repeatedly.

The stereograph, of all visual aids, is unquestionably used least by science teachers. Yet the stereograph because of its low cost, and its three-dimensional pictures, with perspective, should have an especial appeal to any biology teacher with a limited supply of actual specimens, or to the teachers of general science and physics with an inadequate supply of laboratory apparatus. Of all pictures the stereograph is the nearest approach to reality.

It is quite likely that the most important developments in the immediate future as to visual materials of value in science will be in the field of motion pictures. Modern 16mm. projectors, both silent and sound, are now available at comparatively moderate cost. These projectors are portable, compact, easy to operate, present no fire hazard, and are capable of giving results approaching theatrical quality. Such machines have in large measure eliminated the former mechanical handicaps of cumbersome, unsatisfactory projectors, some of which required an able bodied contortionist for the threading operation alone. The lack of suitable films of worthwhile educational content has in recent years been the most serious obstacle in the use of motion pictures in science. It is probable that developments in the immediate future will be an increased supply of satisfactory films, such as the University of Chicago series of sound films in science. An ever-growing list of industrial films also presents interesting possibilities for the physics and chemistry teachers. Further than this, an almost certain development is that the alert science teacher will use a high grade 16mm. motion picture camera and make his own films. Any science teacher may take a camera, such as the Filmo manufactured by Bell & Howell, and make motion pictures of almost professional quality. The biology teacher may use cine-microscopic attachments with these cameras and record motion pictures of any of his microscopic specimens.

Finally, judging from observations made by the writer, visual aids are used much more extensively in college science than in the high school. Yet college science teachers are virtually unanimous in stating that these materials should have the greater practical value in the high school. The writer ventures the suggestion that visual materials will never be used extensively in the high school sciences until the college teachers train the students, who are later to become teachers of high school science, how to select and use visual materials that should have a practical appeal in high school science.

"How may school rivalry in 'brains' be fostered?"

A very practical demonstration of the possibilities of "mental contests" has been carried out at the Rhode Island State College, Kingston, where for the past few years Dr. Ralph K. Carleton has sponsored the chemistry contest. Thus brain vies with brawn for recognition.

SOME OBSERVATIONS ON TESTING PROCEDURES IN CHEMISTRY

RALPH KIMBALL CARLETON

WITH the rapid development of various kinds of "new-type" tests in recent years, more attention is being paid to their adaptation to science subjects. This is especially true of chemistry and physics, more particularly the former subject. The physical sciences are peculiarly adapted to exact measurement of achievement because of the specific and definite nature of their data.

An excellent opportunity has been provided to try out different forms of tests on high school students over a period of years in the series of annual chemistry contests, which has been held at Rhode Island State College since 1924. The contests have occurred yearly in the early part of May as a part of the activities of the Annual Interscholastic Track Meet which has been held for the past quarter of a century at the college. On this day about 1500 high school pupils come to Kingston, and a friendly rivalry is shown between the different schools. The chemistry contest has added much interest to the events of the day. For a competition of this sort, a definite kind of examination had to be developed,[1] of a type that could be taken in a limited time, and corrected expeditiously.

TYPES OF TESTS

Tests are in general broadly classified as being either of the subjective type or the objective type. There is, however, no sharp line of demarcation between the two classes. Because of the circumstances of the contest only objective forms could be employed.

The True-False type of item. The true-false item is a statement in which the pupil responds by marking it true or false. It is an old standby form of test and served well in a number of the contests. The chief disadvantages of this kind of item are (1) that it encourages guessing, (2) that teachers are liable to get into the habit of excising statements verbatim from the text. Both of these disadvantages may be remedied; the first is counteracted in part at least by making a correction for guessing, and the second by care and thought when the test is being made out. The chief advantage of the true-false items are ease of construction and of scoring.

The Multiple Choice type of item. Variations of this type which are termed "matching" or "selective response," were found to be quite suitable in the contests. From all points of view it is one of the best types of items to use. The most satisfactory form appearing in any of the contests

1 Prof. F. W. Keaney furnished the questions from 1924 to 1931; Prof. R. K. Carleton supplied them for the remainder of the period. Other members of the staff were helpful critics.

was that used in 1935, in which a statement could be answered correctly by only *one* of three printed answers.

The Analogy type of item. Another kind of question which was tried out for the first time in the 1935 contest and which yielded excellent results was the "analogy type." This involved a proportionality between short statements or between chemical words or symbols. Three terms of such a proportionality were stated and the student was required to supply the missing term. The chief advantage of this kind of question lies in the possibility of *only one* response, provided, of course, the given three terms are properly chosen. It further appears that ambiguity is more readily eliminated from this sort of question than from any other.

Problems and Equations

Problems. No test in chemistry would be considered complete without a few problems at least. Any student who has graduated from a standard secondary school should be able to solve satisfactorily the so-called fundamental type problems of chemistry. Under that heading might be included the following kinds:

1. Calculation of molecular weights.
2. Determination of proper formulae.
3. Percentage composition.
4. Weight calculation problems.
5. Gas problems.
6. Weight-volume problems.
7. Molar and normal solutions.
8. Molecular weights of gases.

Equations. In order to balance even a small number of chemical equations, a good deal of time must be consumed. The length of time allotted to the Rhode Island State College contest was one and one-half hours. It can be readily observed that relatively few equations handled in the ordinary manner could be included in the test. Therefore, in the 1935 contest twenty-five equations were given, correctly balanced and the student was required only to place a letter in a blank following each equation, indicative of the color or kind of gas or precipitate produced. If neither resulted, the space was left blank.

Modification of the standard type of equation. A unique modification of the standard type of equation was tried out in the 1935 contest. The formulas of two different chemical elements or compounds were stated. The one at the left side of the page was the compound with which to start, and the one at the right was the final product. The student was expected to use his knowledge of different chemical reactions and think through the necessary reactions whereby the second compound was arrived at from the first one which was given. In the middle of the statement, he placed the formula of the correct element (or compound) derived from the first which would yield the second.

Certain advantages appear to be outstanding in regard to this form of equation. There can be but *one* correct answer; although it is brief, it demands clear thinking on the part of the student. On the other hand, unless a student possesses sufficient knowledge of the fundamental reactions of chemistry to enable him to get started, he can make absolutely no progress toward the proper solution.

Results of the Contest Series

It would seem to the writer that the contests have more than met the original objectives, which were, first, to interest high school pupils in the science of chemistry, and second, to assist in building up a healthy spirit of competition between the secondary schools of the state of Rhode Island. In addition, observations of educational value to teachers have been made; certain of these are presented briefly:

Variations in test grades. The tests, when scored, were recorded in terms which subsequently were converted into percentages based on the maximum score possible for any single contest. The lowest percentage rating obtained by any individual contestant was 6.0% in 1928, which may be compared with the highest percentage rating for any lowest-ranking individual of 54.0% in 1931. The highest-ranking contestants for the different years maintained a more nearly constant percentage rating, the lowest being 77.0% for 1930, and the highest 97.8% in 1931. The median percentage rating also showed a relatively lower variation than that exhibited by the low ranking individuals in each contest. The lowest median percent was 45.0% in 1930, and the highest median value was 77.0% in 1931.

Error frequency in question material. For obvious reasons question material had to be varied more or less from year to year. Regardless of the schools or individuals competing, certain kinds of question material seemed to provide much greater difficulty for the contestants than did others. A tabulation follows which indicates the ten most difficult topics, arranged in decreasing order, as shown by the number of times the questions covering these topics were wrongly answered. No distinction was made between arithmetical errors, which were responsible for the wrong solution of a problem, and a person's inability even to attack a problem.

Table I.

Composite Table Showing Types of Question Material Answered Wrongly with Greatest Frequency

Order of Frequency	*Question Material*
1	*Gases and gas problems.
2	*Valence.
3	Decomposition reactions.
4	*Weight calculation problems.
5	Oxidation reactions.
6	Determination of formula from data.
7	*Calculations for molar and normal solutions.
8	Calculation of water of hydration.
9	*Facts relating to industrial processes.
10	*Names and correct formulae of compounds.

* Indicates those topics which appeared every year.

This tabulation brings out two significant facts. Apparently, those topics which involve much theory and demand the exercise of considerable imagination are difficult for high school students. Such topics as Nos. 9 and 10, wherein memorization of data and the acquiring of factual knowledge is a major requirement, are answered more readily by pupils of the secondary school than those which demand the exercise of imaginative effort and the consideration of much theory. Why should this be so?

May not the explanation lie in the fact that the apparently difficult topics require an ability to think for one's self? How often is the complaint made that students know facts but are unable to draw generalizations and conclusions, and—all in all—to think through a problem which differs only

slightly from the material which has been so carefully memorized in the textbook. Reasoning ability seems so seldom inborn and so slowly acquired! How much easier a teacher's task would be if there were some method whereby all students might be endowed with this ability!

Students in general, whether in high school or in college, always find it easier to learn and retain facts relating to industry and industrial processes than to think through a problem to its logical conclusion. Memorization of descriptive matter is not hard, requiring as it does the exercise of little or no original thinking; and, for that reason, questions of that sort are usually well answered. From the teacher's point of view it is more difficult to evaluate properly a descriptive question than it is to judge a question which demands the application of the reasoning process.

Conclusion

A testing program should possess certain major objectives. The first should be to evaluate the student's interest and appreciation of the subject; the second should be to measure the development of power to reason and think for one's self. These, in the judgment of the writer, rank ahead of any measure of achievement in memorizing facts and formulae. There will be, no doubt, concomitant outcomes of value. This has been true of the Rhode Island State College contests, which have provided an excellent means of showing to hundreds of students that there may be effective competition in an academic subject as well as in athletics.

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"How may the public be interested in the school?"

Denver knows a plan that brings out the people! Science leads in the demonstration, and Prof. Robert Collier, Jr., of the South High School in Denver, Colorado, gives practical suggestions for a public display of what the schools can do.

A SCIENCE NIGHT PROGRAM

ROBERT COLLIER, JR.

THE most notable public entertainments that our school offers are our bi-annual "Science Nights." No programs are remembered longer or cause more favorable comment. Parent-Teacher meetings, operettas, plays and dances come and go, but in the eyes of the public of Denver, the outstanding activity of each season is our "Science Night."

The most recent of these events drew an audience of over 5,000 spectators from all parts of the city, as well as the smaller towns within a radius of one hundred miles. These people came and stayed, spending the entire evening enjoying the displays which had been arranged by the various members of the student body. Many who are not patrons of the school, and who ordinarily care little for the activities which they as taxpayers support, were present and whole-heartedly endorsed this interesting exhibit.

The term "Science Night" is used primarily from the standpoint of the presentation of a scientific exhibit, but it might well be called an "Open House," "Science Fair," or any attractive name which will serve to obtain interest of the general public. After all, it is not so much the parents of the children in school that need to be informed concerning the activities of our modern school, but the taxpayers in general.

The organization of such an event requires considerable thought and preparation over a considerable period of time. The actual physical preparation, however, requires but a short time before the event. The possibilities of such a "Science Night" are limited only by the imagination of the teachers and students concerned with such an exhibit, and their willingness to put forth real effort in arranging the necessary displays. The teachers should by no means provide all of the effort, but a live and sympathetic guidance must be supplied to students who will explain and display the various exhibits.

Every department in school has its share in such an event. For example, the necessary publicity is handled by articles written and submitted for publication by Newswriting classes in the English department, while the Art classes furnish a splendid display of posters which are distributed widely throughout the city telling others of the entertainment. The mechanical drawing classes make various direction signs, titles for exhibits, and furnish an exhibit of the work of the members of its department.

When the evening arrives, guides from the outstanding extra-curricular organizations serve to direct visitors who are unfamiliar with the building. Our commercial arithmetic classes are given practical experience in checking

attendance and supplying statistics necessary for complete reports of the evening's activities.

Two or three police officers are present, having a quieting effect on some of the younger boys and girls who are apt to become rather noisy and boisterous.

The home economics department is offered a remarkable field for the display of exhibits in the education of the consumer. In the present field of cosmetics, for example, articles costing one cent are retailed many times for one dollar, giving unwarranted profits to the manufacturer and little or no value to the consumer. Just because an article is recommended highly by radio advertising is no reason for the purchase of the same at exorbitant prices. Studies of "slack fill" in packaged goods, size and count of threads in silks and linens, the amount of water in proportion to pulp in canned tomatoes, the amount of cotton in so-called "wool," the amount of dilution in vinegar, all form a series of investigations that can be used by the classes in home-making in preparation for their part in "Science Night."

A list of projects is prepared from the suggestions of all members of the class. The assigning of such a list for study invariably introduces many other projects, and information on these can be obtained by energetic students from various agencies in the city and country. The results of such projects are carefully checked by the instructor as soon as completed, to be sure that no information will be offered which is not thoroughly substantiated by evidence. For example, the testing of milk by the usual Babcock method is not a difficult task for a high school student. However, should the milk tested be obtained from a sample taken after the cream has been poured off for coffee in the morning, a very low butter-fat content would be shown. If this is reported, the dairy which supplied the milk would, of course, be unjustly criticised for poor milk if such a report of low butter-fat content were allowed to be made public. Similar situations may arise in connection with the testing of coal, gas, and other articles of common use in the home. Therefore careful checking of students' results is essential.

Boys and girls are taught, through an exhibit on consumer education, to read the labels found on a package. They see for themselves that the best article is not always the most advertised. The only limit to the articles that can be tested lies in the number of students interested and willingness to coöperate. Cold creams, tooth pastes, bread, meats, canned goods, gasolines, oils, cosmetics, all furnish a great series of problems which can be studied, the results of which are interesting to the general public.

As information and samples thus collected in a class are assembled, they should be mounted in a permanent form and preserved from year to year. Such a collection gives a foundation for future "Science Nights" which are easily and quickly assembled. Then with careful study they can be explained by other students as well as by those who originally made the exhibits.

Other departments have aided in "Open House" demonstration with much credit to themselves. The customs and habits of people in the various countries of the world, together

with their advancement through periods of history, gives the social science department a most interesting project. Dramatization of various books and short talks will bring members of the public speaking department to the attention of the visitors. The language departments showing motion and still pictures and costumes of their respective countries will always interest the citizens of America.

The "Night" offers opportunities for the demonstration of talent of students in their various hobbies conducted outside school hours. Such activities as soap carving, the making of miniature airplanes, collecting stamps, poetry, flowers, and photography are given the space they require. In addition, many interesting outside attractions are at times available, either in the line of industrial motion pictures, speakers, or demonstrations available from commercial houses, which, while at times frowned on by school authorities, still lend an interesting touch to an "Open House Night," and many times will swell the numbers in attendance.

Possibly the greatest value of such a "Science Night" comes to the student who participates. He must know his project if he is to be questioned concerning it by the visitors to the demonstration. Therefore a thorough knowledge of the subject is necessary, or the student will be thoroughly ashamed of himself by the time the demonstration closes. If he does know his subject and can explain what he has accomplished, even though it is only to his smaller brothers and sisters, he acquires a feeling of importance that is difficult to measure. He takes more interest in his school work. He can compare what he has produced with that produced by others of his class. At the same time our friends and patrons begin to get a better idea of what goes on in the school of today.

It does not require much memory to bring back to the elders what opportunities they had when they were in school. It makes them feel that they, too, would like to come back to to school once more and learn some of the interesting facts that are made available to their children. After all, if we can stimulate a live interest in the supporting public for the work of our schools, then our schools will never fear for proper funds necessary to provide a true education for every coming citizen.

"How can I make them work?"

The plea is that of every Committee Chairman who labors without coöperation from his colleagues. Learning that Dr. Ira Davis, Department of Educational Methods in Science, University of Wisconsin, had found ways to keep state-wide committees active, we asked him to reveal his secret scheme.

HOW TO MAKE COMMITTEES FUNCTION

IRA C. DAVIS

A COMMITTEE must have a significant problem if it is to function with any degree of success. Each member of the committee must be interested in the problem and be capable of contributing to its solution. The problem must be defined. In defining the problem it becomes necessary to place limitations on its scope. These help to eliminate the apparent irrelevant features of the problem at the beginning, but at the same time they may keep it within too narrow a scope. A committee usually finds it necessary to redefine its problem after some progress has been made, with the result that some of the limitations may be removed or others may be added.

A committee must set up its own regulations if it is to make progress. Our science committees in Wisconsin have two regulations which we find very helpful. These are: (1) each member of the committee must answer correspondence promptly, and (2) complete his share of the problem by the date specified. Failure to do so automatically removes that member from the committee. The committee also sets up its goal for the progress it is going to make by a certain date. If a certain goal is to be reached in one year, then the steps which are necessary to reach that goal are carefully planned and agreed upon by the committee. If there is to be a division of work, each member agrees to do his part of it.

In planning for progress at a certain date in the future, it becomes necessary for a committee to make reports at stated intervals. These reports may not be as well thought out as they should be, but unless a report is made, a committee has no way of knowing how it is progressing. A poor report is better than no report at all. Postponing the date of a report hinders the committee in reaching the goal it has set.

Each member of the science committees in Wisconsin is given an opportunity to express his opinion on all of the phases of the problem. Each opinion is carefully considered and weighed by the other members. In our so-called subject matter achievement tests, each member constructs his own test before any discussions are held. Each test represents the opinion of that member. He is free to make any kind of a test he thinks would be suitable. Then at the meeting of the committee each of these tests is submitted to all of the members for their reactions and opinions. Each member marks in the manner agreed the questions he thinks should be retained in each of the tests, the questions which are of doubtful value, and the questions which should be eliminated. This is done without any discussion as a group. After all of

the tests have been marked in this way, each member presents his reasons for constructing his form of test. He may also give his reason for including the questions which have been eliminated or questioned by a majority of the committee. Others may show that a certain question does not have curricular validity, or that it is poorly stated with the result that several different answers may be correct.

When all of the tests have been presented and defended in this way, the committee begins to see the necessity of positive decision as to the form or forms of tests which may be used. At the same time questions may be raised about the whole testing program. They begin to ask themselves, "What are the fundamentals of a good test?"

At their first meeting the committee agrees upon the possible forms of tests that may be used. Usually two or three more forms are selected than will be used in the trial test. Then the acceptable questions from all of the tests are grouped in the forms agreed upon, typed, and mailed to each member. This part of the work is done by clerical assistants. Each member of the committee again ranks all of the questions as to suitability, and mails them to the chairman. The new group of acceptable questions are typed and remailed to the members. They then check each item for curricular validity, and answer the questions which have been accepted. These answers are mailed to the chairman and the answers are tabulated for the members at the second meeting.

The second meeting is devoted to checking the curricular validity of the different questions, further discussion of some questions, and the rearrangement of the questions in the different forms of the tests. The most undesirable forms are eliminated and possibly some new questions are added. These questions include facts, theories, laws, principles, observations, applications, nomenclature, interpretation and reasoning. Usually one form of the test is assigned to one or more members for a more careful statement of the questions, and a further checking of the different factors which effect the reliability and validity of the test. The revised forms are typed and each member tries out the test with other teachers and possibly with some pupils.

After these preliminary trials have been given, the revised tests are sent to the chairman and placed in form for trial use with about 300 students. Assistants give the tests and do all of the preliminary scoring and make all of the statistical calculations. After the scoring and calculations have been completed, the committee meets and rearranges the questions in their final form and the test is ready for statewide use.

We now have subject-matter committees in general science, biology and physics. A new test is constructed for each subject each year. A committee in chemistry will be organized next year. We also have a committee developing new tests for scientific attitudes, scientific methods, and the other phases of the Wisconsin philosophy of science teaching. Our State Education Association is supplying the funds for the necessary expenses of this committee.

The chairman of the committee using the procedure I have described has important functions to perform. He must give each member the opportunity to present his opinions. He must help summarize what each mem-

ber has presented. He must also introduce questions and offer suggestions for the summarizing of the opinions of all the members. On disputed points the differences must be stated clearly, and usually they will disappear when the issues are plainly defined and explained. The chairman is responsible for carrying along the summaries. These should be made frequently. They help to clarify the thinking of the whole group. The success of the chairman seems to depend on his ability to lead the committee toward sound conclusions, on his planning in keeping the work up to the schedule set, and on being the best informed member for that particular problem.

The chairman must not let any personal feelings enter the discussions. Each member, as well as the chairman, must learn to "give and take." The members must respect the opinions of others, but must not be afraid to disagree. They should help others clarify their thinking whenever they have anything to offer. Many times group discussions do not seem to be producing any results. Soon some member makes a statement which helps the whole group clarify its thinking, and from that point on the progress is rapid.

It should not be necessary for members of a committee to do any unnecessary clerical work or to make simple statistical calculations. Funds should be provided for this work. It is also advisable to have funds to pay the necessary traveling expenses. However, the budget for this committee work need not be large.

The test committees operate in cooperation with the Wisconsin Education Association, the University, and the Superintendents and Principals Association. Last year fifty per cent of the schools gave the tests and the final statistical calculations were based on approximately 4,500 papers. The Department of Tests and Measurements in the University makes the final statistical calculations and sends the interpretation of results to the cooperating schools.

The attitudes and methods tests have been used only in experimental form with a few schools. As soon as the committee feels these tests have reached a form where they have validity and reliability, they will be used on a state-wide basis and will also be available for schools outside of the state, if they are wanted. The subject-matter and attitude tests are published by the E. M. Hale and Co., Eau Claire, Wisconsin.

"Is 'nature' or 'science' to be emphasized in the grades?"

An offering called "elementary science" has risen to compete with the long-established "nature study" at elementary levels. The newer movement has published its point of view, and we have sought the older movement's viewpoints from Dr. E. L. Palmer, long an associate with Mrs. Anna B. Comstock and Dr. Liberty H. Bailey at Cornell. Dr. Palmer is President of the American Nature Study Society, and editor of the Cornell Rural School Leaflets.

COMMENTS ON THE CONTROVERSY BETWEEN NATURE STUDY AND ELEMENTARY SCHOOL SCIENCE

E. Laurence Palmer

THIS is not written with the thought of stimulating controversy, but rather to answer certain published criticisms of work in nature study. The writer agrees thoroughly with Craig[1] that the "important question is not what we shall call this subject, but rather what service is to be rendered to the child."

Some, not so well informed as to work in nature study as Craig, have not been so reasonable. Much that is now being offered as elementary science is so remote from that to which the writer can subscribe that an evaluation of some of these offerings in terms of the long established ideals and practices of nature study may be of interest. So far as known some of these unwarranted criticisms have not been answered in print.

In the March, 1933, issue of the University of Michigan School of Education Bulletin, page 86, F. D. Curtis states among other things: "At its best nature study has been found to consist chiefly of identification and observation of living plants and animals, . . . its content has been exotic, being composed of *discussions* of . . . hippopotami . . . and other topics *romantically remote* from the humdrum familiarity of the child's environment." (The italics are inserted for emphasis by this writer.)

With the statement that nature study may consist, in part at least, of observation of living plants and animals, the writer has little disagreement, but the subject certainly has not emphasized the study of objects *romantically remote* to the extent that many leaders who seek the elimination of nature study have done. In Cornell Teachers Bulletin, published in May, 1897, L. H. Bailey says: "The proper objects of nature study are the things that one oftenest meets"; and, "The first essential in nature study is actually to see the thing or phenomenon." Those who have succeeded Bailey in this work at Cornell have seen no reason to modify his views, although it is recognized that at least in the upper grades vicarious experiences may have their place when the child has had experiences which make it possible for him to judge the offerings of others.[2] To the writer's knowledge the leading advocates of the study of hippopotami and other *romantically remote* materials have preferred to identify them-

1 Craig, G. S. Thirty-first Yearbook, National Society for the Study of Education, p. 151, 1932.
2 Gilbert H. Trafton, in "Outline of Nature Study," page 9, 1915, says of the materials of nature study that it is necessary that the child "should have actual concrete material to observe in his lessons."

selves with elementary science rather than with nature study.

An example of the study of hippopotami is found in the third grade "Tentative Course of Study in *Elementary Science*," by G. S. Craig, where on page 33 he says, "Sometimes a mother hippopotamus is seen in the Nile River with a calf astride her short neck." Further he says, "Baby monkeys are often carried about among the branches by their mothers." And to further develop the idea of parental care he chooses other *romantically remote* illustrative species, such as the Columbia River salmon, the Canada otter, and the prairie wolf. Little or no emphasis is given the ants, starlings, dogs, cats and humans that illustrate parental care in the romantically near sidewalks of New York near Morningside Park. If nature study and much that is offered as elementary science divide on the study of the remote and the intimate, I have failed to find justice in Curtis' criticism that nature study concerns itself with the remote and elementary science with the immediate. The contrary seems to be the rule.

In his article, Curtis further criticizes nature study on the grounds that it "has consisted of the reading of nature poetry, of the telling of nature fables and fairy tales," etc. Certainly this criticism is not true of the offerings of Jackman, of Comstock or Bailey, or of many other supporters and makers of the nature study movement. Bailey, in the source quoted, says, "Accuracy is a prime prerequisite of any good nature study, for accuracy is truth and it develops power." It is unfortunate that in any literature designated as nature study *or* elementary science false statements appear. One book, recommended by Curtis in the very article in which he criticises nature study for superficiality, tells us that deer need horns to push back the snow to uncover their food. If this statement raises in the child the challenge to know how the hornless does and fawns survive, or even how the bucks succeed after their horns are shed, it would not be so bad, but no provision seems to be made to meet the issue. It is comparable to a statement which once appeared in a nature study book adopted by the state from which skeptics claim their origin. This statement—not prepared by anyone who was ever prominent in nature study circles—tells that a skunk scatters its scent by first spreading it on it tail, and then shaking it off as water is shaken from a broom. I give this amazing story here to show that errors are to be found in nature study publications as well as in those designated elementary science. The point I make is that the critics of nature study are themselves open to greater criticism if their work is compared with that of Bailey or Comstock.

No one should fail to give credit for the stimulus to good work in natural science which has come from the advocates of elementary science. When we come to consideration of the emphasis on the study of generalizations or the understanding of principles, there are some dangers which are not recognized by all. There is considerable honest difference of opinion on some of these points.

On page 17 of the 31st Yearbook of the National Society for the Study of Education, Powers states that the accepted principles of nature study hold that "Nature study should be primarily observation of common nat-

ural objects and processes; the grouping of the facts learned in nature study to form principles and generalizations should be reserved for college study." I am not ready to consider that such a statement can be considered wholly as a criticism. When it is followed, as it is on pages 53-55, by a list of thirty-eight principles and generalizations to be used in the selection of specific objectives, one wonders if vicarious experiences may not in a practical situation be substituted for the real ones. It is not wholly just, however, to hold that the advocates of nature study have always recommended the reservation of the formation of generalizations to the higher grades. It depends upon the generalization.

Bailey, in the first sentence published in the Cornell Nature Study Leaflets and written as Teachers' Leaflet No. 6, May, 1897, says: "Nature study, as a process, is seeing the things one looks at, and the *drawing of proper conclusions* from what one sees. Its purpose is to educate the child in terms of his environment, to the end that his life may be fuller and richer." It seems improbable that Powers could have had such a statement in mind when he wrote his definition of nature study's objectives.

Apparently the thirty-eight principles advocated by the 31st Yearbook fell on a fertile field. Three years after their publication they have increased to 113 for consideration by the elementary school alone, if we can accept the judgment of M. L. Robertson, as published in the February and April (1935) issues of *Science Education*. The fact that these are stated as *ultimate* goals for consideration in the elementary school does not disturb Mr. Robertson, even though it would seem that what is needed would be a list of those goals which would be *immediately* rather than ultimately significant at that grade level. When a child learns to add two and two he has an elementary school experience whose ultimate goal might be expressed in the most profound mathematics.

Anyone can recognize merit in the move to establish elementary science which does not confine itself to the study of the immediate environment. Not everyone can recognize the wisdom of its organization primarily around principles or generalizations. There may be many realms of experience from which activities may be chosen. These activities may or may not be significant in terms of generalizations which may be immediately formed. Darwin made a generalization after years of experiences in a realm which interested him. It was partly right and partly wrong. Had all subsequent investigations in the field been selected merely to prove his generalizations, the procedure would have been neither intelligent nor profitable.

"How may I sponsor a successful science club?"

This question is asked by an army of science teachers who find the activity none too easy. The club activities of Tulsa, Oklahoma, have long been noted throughout a wide region, and we asked Miss Edith R. Force, of the Woodrow Wilson Junior High School of that city, "under whose direction a club just HAS to succeed," to give us details. She did—voluminously—and we publish what our space permits.

SPECIAL ACTIVITIES OF SCIENCE STUDENTS

EDITH R. FORCE

JUST another "science club," the uninitiated may say. Nevertheless, we believe there is a difference in that *this* club has been a vital factor in life outside of the classroom. It is the "follow-through" in golf or baseball which makes the superior plays. Public life is strewn with the derelicts of past hopes which failed because someone was not hopeful long enough. Our Field and Stream Club has been active for ten years; it is possible, therefore, to measure in part the values of the club that "carry on."

The simple organization is much the same as when it began. The membership is elective, open to any boy or girl with any type of nature curiosity or interest. Leadership is sought—and always found—among those who have been in the club previously, or among the older students with more formal science classroom training. Enough such leaders are recruited, in a general club membership limited to forty, to make each "captain" responsible for two, three, or at the most four other students called a "group." Sometimes the group has like interests, sometimes the interests are varied, with an effort being made to enlarge the viewpoint of each one of the individuals. An attempt is made to give the "captains" regular weekly training in the methods of leadership as well as in general nature-study information. As many field trips as can be arranged are conducted by the sponsor. In turn, the leaders are required to take their "group" on at least one field trip a month. The result is usually a field trip at any available opportunity. Here is a delight and also a danger. Not all of the field trips should be "picnics" or "joy jaunts." A definite aim and a definite outcome should be sought even in a very limited area encompassed.

A "Handbook of Suggested Activities" has been compiled as an outgrowth of the desirable things which may be done in nature study in the school, at home, or a-field, either by groups or by individuals. Each of these activities has arbitrarily been assigned a certain number of "points," an accumulation of which leads to "honors." The honors are of the simplest sort. A blue ribbon bow is the high honor within each group. Thus ten to twelve students may win here, in a group of forty. In the whole club membership, exclusive of the "captains," high honors are rosette badges of white, red and blue, and silver and gold pins in order of accumulated points. These pins have been made from an individual design and may not be bought or used for any purpose except "activity honors." The leaders have pins of a different design, and do not compete against the indi-

viduals of the groups. Should it happen that the same student receives the highest honors two semesters he may be awarded the gold membership pin of the International Natural History Association (headquarters in San Francisco, Calif.).

It was found that members carried the inspiration of their contacts in the club out beyond the junior high school years. From this grew the suggestion by one of the club presidents for a "Life Membership Certificate" for those who retained their nature study interests.

As time passed there grew an increasing list of friends of the organization who in some manner contributed to programs or work of the club. These we delighted to honor, as they in turn honored us, by presenting to them publicly, upon the vote of the members, an "Honorary Life Membership" to the Field and Stream Club. Thus has been established a strong bond of friendship and fellowship of the boys and girls and adults which is invaluable! A further desirable step in this direction is now in progress through the contemplated recognition of the club as an auxiliary or an affiliated unit of the local Zoological Society, Audubon Society, Garden Federations and state Junior Academy of Science. The value to both junior and senior groups can be easily discerned.

May I take the subject of ornithology to illustrate one project which has had unlimited outlets for student activities? Beginning as a Junior Audubon Society, an attempt was made to learn at least fifty new birds in one semester. All of the visual stimuli available were used, such as charts, books, lantern slides, puzzles, victrola records, feeding stations, bird-house contests, exchange letters with other states and counties, and countless other means. The enthusiasm leaked out into the community. A survey to contact the isolated individuals and any city organization interested in nature-study was made. These were urged to contribute their knowledge as a beginning to authentically established records of the wild life of the community. The taxidermy shop was interested; the dilapidated, rusty specimens in various schoolrooms and hunting lodges were checked, and such nature diaries or geological survey accounts as came to light from pioneer residents were gathered together. Hunting records were followed, birds killed by accident were salvaged, government permits were used by the instructor for collecting and banding purposes, accurate museum records were kept, sight records were collected from authentic observers, and not the least of these were the junior high school boys and girls.

The results are seen in a nest collection made by the students after the birds were recorded and observed in the nest, and identity established for a certainty. An egg collection was donated by an experienced zoölogist, for egg-taking requires a license and has never been encouraged among students. The bird collection, representative of the residents and migrants of the locality, in a large part is made up of study skins which were originally sent to the U. S. Biological Survey and other recognized national ornithologists for the checking of identifications. From these data has been compiled a "Time Table of Birds of Tulsa County and Vicinity," which has been published. Such items of interest to the state were presented in

the Oklahoma Academy of Science Proceedings. Emphasizing the hunting with field-glasses and camera instead of the gun, an annual Christmas Bird Census has been participated in by the students for more than ten years, with reports being made to *Bird Lore*. Contacts with such organizations as the National Audubon Society, the Inland Bird-Banding Association, the Wilson Ornithological Club, and various state bird study clubs, have been sought at all times. Newspaper articles and feature stories have educated the general public to the growth of the idea, until time was auspicious for the organization of a City Audubon Society, which has increased its membership to one hundred in less than eight months. Pleasant relationships with the City Superintendent of Parks, support of wild life sanctuaries, surveys of migrating birds, and many other valuable activities are continuing from the pioneering in this field.

Many examples of happy vocations resulting from membership in the Field and Stream Club may be cited. One senior high school student, guided by her father, has prepared a simple key to trees of the county, to be used by nature scouts and 'teen age students. A junior in the city University has become the zoology assistant, still retaining his bird interests for research study. Another University student has done a commendable job in the determination of the amphibians of the vicinity through his major studies. Another boy, just about to enter the University, has declared himself for a life study as a paleo-botanist. A girl who has graduated from college, and is taking an art course in a distant City, writes: "How is the Field and Stream Club? I will always be glad I was a member. . . . It put me in a sympathetic attitude with nature and the things about me. I find in my landscape painting that I have a better understanding of the moods of nature than the other students do."

Yes, the boys and girls are growing up—and education is facing new objectives, such as *Perfect Health, Elimination of Crime, Abolishment of War, Happy Adult Life and Harmonious Homes, A Good Sensible Standard of Living, Citizenship Taught With a Kindly Rigid Discipline.* Will not these products of the Field and Stream Club stand the test?

EDITORIALS

H. L. Caswell, Otis W. Caldwell, Hanor A. Webb,
S. C. Garrison

SCIENCE IN THE CURRICULUM

A great deal of scientific knowledge is unquestionably essential for the understanding of contemporary life and for effective participation in many of its activities. On every hand situations are encountered which are made meaningful by scientific understandings, and problems arise which can be solved only through application of scientific procedures and techniques. Consequently one who is interested in developing a school curriculum adjusted to contemporary life gives science a prominent place in his thinking, and is sympathetic with the efforts of specialists in science to secure for science greater consideration in the school curriculum.

These efforts, however, have certain characteristics which appear unfortunate to some who are interested in the development of the curriculum as a unified, functioning whole. Among these characteristics is the unquestioned use of scientific principles, laws, and generalization as the primary basis for organization of curriculum materials in science. This is the basis upon which traditional high school science courses rest and is now being employed in the programs of science being extended into the elementary school. This approach is essentially that of a logical organization of science. It encourages the consideration of science as a field of study rather than as a means of dealing with problematic, lifelike situations. It makes difficult if not impossible the development of a curriculum in which science materials along with materials from the other subjects are related to significant functional aspects of life. In these regards the procedure is contrary to the trend in thought and effort in general curriculum development.

This is a point to which those working in the field of the teaching of science may well give careful consideration. Shall science be organized to facilitate mastery of the subject matter of science, or shall it be organized to encourage direct use in meeting lifelike problematic situations? Shall there be a science curriculum or science in the curriculum?
—H. L. Caswell, Division of Surveys and Field Studies, George Peabody College for Teachers.

THE INTANGIBLE PAY OF A TEACHER

(I have been asked to provide this personal statement. To tell one's own story is too much like appearing in public without proper clothing, so I have merely glimpsed a few of my naked experiences.—O. W. C.)

My first district school teaching must have been miserably poor. My cash payment for the six months was a total of two hundred sixteen dollars. Each teaching month included twenty days of school and one day of teachers' institute. Bad as my teaching days may have been, the institute day was worse because reading abstract educational philosophy was a foreign language to me. I had my eighteenth birthday soon after the opening days of school. There were fifty-five pupils in the school, five of whom were my cousins. There were seven "big boys" of about my own age. There were five of the six-year-old group, whose parents hoped they would learn to read. During each day I had twenty-nine classes made up of boys and girls about equally distributed. These were very rural pupils, ranging from a low but harmless moron to a few who later gained distinction in scholastic achievement.

Though my scholastic preparation was meagre, my knowledge of management of such a school was quite negligible. It was still the custom in that region for the big boys to "run the teacher out" if he were at all susceptible to devices

then in vogue. In knowledge of the assignments for class work, by hard work at night, I could keep one lap ahead of the best pupils, and the others floated along with the current. But in problems of management, due to my lack of psychological knowledge, it was sometimes necessary to retreat to my last line of defense, physical strength, as a means of gaining order, respect, and coöperation. Though I now have little pride in the abandon with which on a notable occasion I subdued the leader of the bullies, there is no doubt that my refusal to surrender to the then-incipient demands of soft pedagogy was the beginning of life-long intangible (not *too* intangible) benefits within that school. After the successful conquest we all had a talk about "What it is we want from this school and how can we get it?" From that day, it became a friendly, playful, working and purposeful school.

Possibly the best thing I did for the school was to decline reappointment, in order to return to college. But during the following decades, as occasional visits presented the opportunity, my small (not too small) financial returns from that school have been supplemented in a large way by reports of the good progress being made by one and another of those who were my pupils. Some of them are grandparents now, but they never fail to extend an intelligent welcome always based upon the work we did together.

My teaching subsequently extended into college and university. A few days ago I received one of a considerable number of large "checks" from former students. This recent check came from one who is eminent in scientific research and has been given the highest type of public recognition by scientific men. His "check" incorrectly credits me with being the one who started him in his scientific career. I say "incorrectly" in all seriousness, for a teacher may recognize genius and guide it for a time, but it exists independently of the teacher and goes its own road when once it has discovered its own ways of operating. Dr. Liberty H. Bailey once said: "He is the best teacher whose pupils the farthest outrun him." We need note the caution, however, that being surpassed by our students does not in itself prove that we have been good teachers.

What a tragedy it would be if one who has taught for more than forty years should not find here and there many devoted, intelligent, unselfish workers carrying their efforts into new areas of accomplishment. Those of us who teach have done our best work when we have put able workers in the way of doing their best. Through the efforts of such workers, knowledge keeps growing, and the uses of knowledge in men's affairs keeps improving. Such so-called intangible benefits thus begin to look like the most tangible of things, less evanescent than money, goods and material gifts. They are more real than anything else in a world that is needy for more and more truth that is in action in the affairs of human life. No one may secure higher pay than is possible for the teacher.—Otis W. Caldwell, General Secretary, American Association for the Advancement of Science.

SCIENCE: FOR ALL, AND FOR EACH

The importance of science education is to be evaluated in terms of how it aids the individual to understand and utilize the processes and materials of the world. This is equivalent to saying that science education is important because it helps the individual to better adjust himself to the world in which he lives. During the last fifty years the discovery and application of scientific principles have changed man's method of thinking and living as nothing else has in a similar period of time. If education is conceived as a purely cultural process relating to the heritage of the race, science teaching must have a very large place, because modern science is more largely responsible for the content of our thought and for our ways of living than any other factor. When we consider what the application of scientific method and knowledge has produced, we at once realize that life was far different in an unscientific age.

Not only is science teaching important from the point of view of its use in the world, but it is equally as important when we consider what a proper study of science does for the development of the individual. The individual's efforts through life are concerned with his adjustment to the world as he knows it. The history of Magic, Medicine, and Religion is largely a statement of the ways man has tried to adjust himself to misunderstood natural phenomena. Science has given modern man a new interpretation of the world and has made it possible for him to develop methods of work, and habits, and attitudes of thinking which free him from the superstitions and fear that so cramped and hindered the development of his ancestors. He is able to lead a more objective and well-ordered life because he can understand and control the forces of Nature better. Instead of viewing himself as the victim of unseen and unknown mysterious forces, he now understands that the events of Nature obey justice, love, and principles. Knowing these, he seeks to utilize them for his own good.—DR. S. C. GARRISON, Dean of the Graduate School, George Peabody College for Teachers.

NATIONAL ASSOCIATIONS OF SCIENCE TEACHERS

The science teacher is gregarious. Of great stimulus to professional spirit are the local science divisions of State Education Associations, and certain organizations of regional influence. There are several national gatherings of science teachers, however, in which the broadest aspects of national problems in science education are considered.

The Department of Science Instruction of the National Education Association was organized in 1894. It convenes at the Summer Meetings of the N. E. A. The programs are of a most varied nature, and classroom teachers mingle their addresses with those of supervisors and noted educators. The organization is thoroughly democratic, and active membership in the N. E. A. is the only fixed qualification for membership. The attendance is usually several hundred, and the range of discussion is practically unlimited. Because of the size of the Department it has not seemed practicable to limit its activities to any specialized field, and the chief responsibility of the officers has been to arrange for a highly stimulating annual program.

Science teachers should make every effort to attend one of the meetings of this Division whenever the N. E. A. convenes in the region in which they find themselves during the summer.

The officers of the Division now active are: President, Dr. Ira W. Davis, President of the University High School, University of Wisconsin, Madison, Wis.; Eastern Vice-President, Miss Mildred M. Fahy, Principal, Amundsen-Von Steuben Schools, Chicago, Ill.; Western Vice-President, Prof. Charles L. Hampton, Piedmont High School, Piedmont, Calif.; Secretary, Miss Vesta Hicks, Supervisor of Elementary Science, Austin, Texas; Treasurer, Miss Esther W. Scott, James F. Oyster School, Washington D. C.

The National Council on Elementary Science was organized about twenty years ago. It convenes at the Winter Meetings of the Department of Superintendence of the National Education Association. Its membership includes supervisors of elementary science in various cities, those who teach methods of elementary science in teachers colleges, and classroom teachers themselves. The most important activity is to present a stimulating program at the annual meeting, and to make the Council's magazine, *NCES News Notes,* practical and interesting.

The officers of the Council now active are: President, Miss Bertha M. Parker, University Elementary School, University of Chicago, Chicago, Ill.; Vice-President, Miss Helen Dolman, Michigan State Normal College, Ypsilanti, Mich.; Secretary-Treasurer, Prof. Harry A. Cunningham, Kent State College, Kent, Ohio.

The National Association for Research in Science Teaching was organized in 1928. It convenes at the Winter Meetings of the Department of Superintendence of the National Education Association. It is a small group, the mem-

bership being restricted by a policy of invitation, and being largely confined to those who are actively engaged in educational research in the field of science teaching. The Association sponsors several committees, each of which is investigating some phase of professional work. There are few organizations that can claim (a) as large a proportion of its membership "active" in a literal sense; (b) so high a percentage of its total membership in attendance at its annual meetings. The official journal of this Association is *Science Education.*

The officers of the Association now active are: President, Prof. Walter G. Whitman, Department of Science Instruction, State Teachers College, Salem, Mass.; Vice-President, Prof. Ira C. Davis, School of Education, University of Wisconsin, Madison, Wisconsin; Secretary-Treasurer, Dr. S. Ralph Powers, Professor of Natural Sciences, Teachers College, Columbia University, New York, N. Y.; Members of the Executive Committee: Prof. Gerald S. Craig, Lincoln School of Teachers College, New York, N. Y.; Prof. Hanor A. Webb, George Peabody College for Teachers, Nashville, Tenn.

The Division of Chemical Education, American Chemical Society. An organization of chemistry teachers, received Division status in the American Chemical Society about fifteen years ago. Although its membership is predominantly college instructors in chemistry, yet every effort is made to interest high school teachers of the subject. The *Journal of Chemical Education* is the Division's official organ. The programs of the Division are given as part of the regular meetings (April, September) of the American Chemical Society.

The officers of the Division now active are: Chairman, Prof. Harrison Hale, University of Arkansas, Fayetteville, Ark.; Vice-Chairman, Prof. F. B. Wade, Shortridge High School, Indianapolis, Ind.; Secretary, Prof. N. W. Rakestraw, Brown University, Providence, R. I.; Treasurer, Prof. Virginia Bartow, University of Illinois, Urbana, Ill.

The American Association of Physics Teachers was organized in 1930. It meets with the American Association for the Advancement of Science at their New Year's convention. Its membership is chiefly among the professors of physics in colleges and universities. The object of the Association is to improve the teaching of physics and to increase interest in the subject throughout the nation. Committees of the Association have devised tests in physics which are used very widely, and a book on "Demonstrations in Physics" is in preparation. *The American Physics Teacher* is the official publication of this professional group. This Association is one of a group of societies that comprise The American Institute of Physics, 11 East 38th Street, New York, N. Y.

The officers of the Association now active are: President, Dr. D. L. Webster, Stanford University, Palo Alto, Calif.; Vice-President, Dr. F. K. Richtmyer, Cornell University, Ithaca, N. Y.; Secretary, Dr. W. S. Webb, University of Kentucky, Lexington, Ky.; Treasurer, Dr. P. E. Klopsteg, Central Scientific Co., Chicago, Ill.

The American Science Teachers' Association was organized in 1934. It convenes at the New Year Meetings of the American Association for the Advancement of Science. Its general aim is to serve as a clearing house for local science problems that seem to have national significance, and to sponsor the organization of local groups of science teachers. In line with the policy of the A. A. A. S., the A. S. T. A. encourages affiliation of these scattered groups, and hopes to aid in the growth of a spirit of professionalism among science teachers. Membership is invited for a small fee, and membership in the A. A. A. S. is not a prerequisite. It is considered highly desirable, however, that membership in a local group of science teachers be the teacher's first consideration, and that groups send representatives to the annual meeting.

The officers of this Association now active are: President, Dr. Harry A. Carpenter, Specialist in Science, Rochester Public Schools, Rochester, N. Y.; First Vice-President, Dr. Morris Meister, Head of Science Department, Haaren High School, New York, N. Y.; Second Vice-President, Miss Ada Weckel, Head of Biology Department, Oak Park-River Forest High School, Oak Park, Ill.; Secretary, Dr. Ellsworth S. Obourn, Head of Science Department, John Burroughs School,

Clayton, Mo.; Treasurer, Prof. Homer W. LeSourd, Head of Science Department, Milton Academy, Milton, Mass.

Space does not permit listing a number of national scientific organizations, not confined to teachers, but in which they are frequently most active. The American Nature Study Society, the Wilson Club (birds), the American Forestry Association, the American Chemical Society, the American Physical Society, and certain others have Divisions in which educational topics are presented. —H. A. W.

PROFESSIONAL MAGAZINES FOR SCIENCE TEACHERS

The science teacher does not labor alone. In the finest spirit of cooperation, fellow workers in the field pass on their philosophies and experiences through many channels. It is characteristic of this age that publications multiply, and that wherever it appears that a special interest may be served, someone is willing to labor as an editor, someone else to worry as manager, and the printers and postoffice reap a bit of profit.

When one considers the tens of thousands of science teachers throughout the nation, it would appear that every professional magazine in that field should prosper. Only a pitiful proportion, however, are patrons of the printed pages in the methodology of their specialty—but perhaps they have not *heard* of the magazines! Possibly they have lost the addresses of the editors and managers!

We will remedy *that* deficiency! There follows a list of the current professional magazines for science teachers, with brief annotations as to their style and function. The order of listing is merely that of annual subscription price:

Cornell Rural School Leaflets; 48-60 pp., 4 issues a year, 50 cents. Editor, Prof. E. Laurence Palmer, Department of Natural Science, Cornell University, Ithaca, N. Y. Published by the Extension Division of the University.

These leaflets are for teachers of science in the grades. They represent a broad view of Nature Study, treating of many familiar forces of nature as well as plants and animals. One larger issue each year is for the teacher, the other three are primarily for the pupils. The illustrations are appropriate, often dramatic. The leaflets have been published for twenty-nine years.

The Teaching Biologist; 36 pp., 8 issues a year, 50 cents. Editor, Prof. Charles A. Gramet, John Adams High School, Ozone Park, N. Y.; Business Manager, Prof. Barnet S. Minters, same address.

These bulletins are full of practical suggestions written by active biology teachers. They are sponsored by the New York Biology Teachers' Association. The magazine is in its second year.

NCES News Notes; 16 pp., 4 issues a year, 75 cents. Editor, Miss Bertha M. Parker, School of Education, University of Chicago, Chicago, Ill.; Associate Editors, Miss Rose Lammel, Colorado State College of Education, Greeley, Colo.; Prof. W. G. Whitman, State Teachers College, Salem, Mass.; Business Manager, Prof. O. E. Underhill, Teachers College of Connecticut, New Britain, Conn.

This two-year-old publication is the official organ of the National Council on Elementary Science, and features very short, practical articles on methods of teaching science in the grades, and notices of new teaching materials.

The Science Counselor; 36 pp., 4 issues a year, 1.00. Editor, Prof. Hugh C. Muldoon, Professor of Chemistry, Duquesne University, Pittsburgh, Pa.; Business Manager, Prof. W. John Davis, Instructor in Law, same institution.

This magazine is offered to serve science teachers in the Catholic High Schools of the United States, but its thoughtful articles from all parts of the nation will benefit the teacher in any public or private school. This is the newest of the science magazines; it has just completed its first year.

The Iowa Science Teacher; 32 pp., 4 issues a year, $1.00. Editor, Prof. Donald D. Pettit, Senior High School, Cedar Falls, Iowa; Business Managers, Prof. D. I. Walker, High School, Newton, Iowa, and Prof. D. C. Stroud, High School, Des Moines, Iowa.

Sponsored by the Science Division of the Iowa Education Association, this magazine publishes the better papers delivered at the meetings in the state, and adds other articles by progressive teachers. It is a courageous effort by a state group to build professional spirit.

Science Guide for Elementary Schools; about 60 pp., 10 issues a year, $1.25. Miss Helen Heffernan, Chief, Division of Elementary Education and Rural Schools, State Department of Education, Sacramento, Calif., directs its publication.

A committee of science teachers, heads of their departments in the State Teachers Colleges of California, write special issues on specific aspects of science taught at the lower levels. This content material is primarily adapted for the Pacific Coast, yet applicable elsewhere. These Guides are in their second volume.

Science Education; 48 pp., 4 issues a year, $2.00. Editor, Prof. Charles J. Pieper, Department of Science Education, New York University, New York, N. Y.; Business Manager, Prof. Clarence M. Pruitt, Department of Science Education, Colorado State College of Education, Greeley, Colo.

This is the official organ of the National Association for Research in Science Teaching. It features the reports of studies in methods of instruction, testing, technique of investigations, book reviews, and professional improvement. It is a serious magazine, designed for college teachers, students in schools of education, and scholarly science teachers at all levels. This magazine is in its twentieth year.

School Science and Mathematics; 120 pp., 9 issues a year, $2.50. Editor, Prof. Glenn W. Warner, South Side Junior College, Chicago, Ill. Business Manager, Prof. W. F. Roecker, Boys' Technical High School, Milwaukee, Wis.

This magazine—now in its thirty-sixth year—has been longest in the service of science teachers. It features practical, interesting articles concerning both the content and methods of both fields of its title. It publishes reports of studies, but deletes tables of data, as a rule. The addresses delivered at the Annual Meeting of the Central Association of Science and Mathematics Teachers (of which it is the official organ) appear in it. Its Problem Department is particularly good.

The Journal of Chemical Education; about 60 pp., 12 issues a year, $3.00. Editor, Prof. Otto Reinmuth, Kent Chemical Laboratory, University of Chicago, Chicago, Ill. Business Manager, Mr. Harvey M. Mack, Mack Printing Co., Easton, Pa.

This magazine serves the chemistry teacher, either in high school or college. It contains much historical and descriptive material; the space devoted to methods of teaching is probably adequate, though it does not predominate. The illustrations are excellent, often of great rarity. The magazine is thirteen years old.

The American Physics Teacher; 48 pp., 4 issues a year, $3.00. Editor, Dr. Duane Roller, Department of Physics, University of Oklahoma, Norman, Okla., Business Manager, Miss Madeline M. Mitchell, Editorial Secretary, American Institute of Physics, 11 East 38th St., New York, N. Y.

This is the official organ of the American Association of Physics Teachers. Its principal articles are somewhat advanced, but there is a most practical section on "Apparatus, Demonstrations, and Laboratory Methods," and teaching plans are likely to be presented briefly in "Discussions and Correspondence." This magazine is in its third year.

Education; 64 pp., 10 issues a year, $4.00. Editor-in-chief, Prof. Herbert Blair, Department of School Administration, Boston University, Boston, Mass.; Business Manager, Mr. Raymond P. Palmer of The Palmer Company, 120 Boylston St., Boston, Mass.

This magazine is published as a series of special issues, each devoted to one active field of education, and featuring short, practical articles of diverse views concerning that field. The Science Issues appear approximately twenty months apart. The magazine is in its fifty-sixth year of publication.

This point should be emphasized: these magazines are written both *for* and *by* science teachers. Most of them (*Cornell Rural School Leaflet* and *Science Guide for Elementary Schools* excepted) will welcome manuscript from any teacher who has an interesting story to tell or a sound philosophy to express.

—H. A. W.

DEPARTMENT OF BOOK REVIEWS

EARLE AMOS BROOKS
PROFESSOR OF EDUCATION, BOSTON UNIVERSITY

Exploring in Physics. By *Reginald J. Stephenson*, University of Chicago. Price, $1.50. 204 pp. The University of Chicago Press, Chicago. 1935.

A sub-title of this paper-bound book speaks of it as "A New Outlook on Problems in Physics." Furthermore, it should be said that it is to be used in connection with a substantial volume issued recently by the same publishers (and reviewed in EDUCATION), entitled *From Galileo to Cosmic Rays*. In the Foreword Professor Harvey B. Lemon, author of the volume last named, says, "This book, together with *From Galileo to Cosmic Rays*, is to be used in our own introductory science course, where the time allotted to physics is limited. . . . The combination of the two books presents enough material for an adequate presentation of the fundamentals of physics in an entire year's course."

Readers of this review who have not yet seen the books presenting the new type of introductory science courses, now offered by the University of Chicago, should avail themselves of the privilege as soon as possible. These books are striking in color, unique, humorous and suggestive in their illustrations, and beautifully printed on high-grade paper. So attractively are the various topics presented that even an indifferent reader, at the beginning, is persuaded to go through the entire book and enjoy it.

The general topics discussed are—

1. Speed and Acceleration.
2. Newton's First Two Laws of Motion.
3. Addition of Vectors. Projectiles.
4. Newton's Third Law of Motion.
5. Work and Energy.
6. Atmosphere and Hydrosphere.
7. Temperature and Expansion.
8. Heat.
9. Molecular and Kinetic Theory of Matter.
10. Electric Charges and Magnetic Poles.
11. Conduction of Electricity in Liquids and Gases.
12. Wave Motion.
13. Sound.
14. Light.
15. Electromagnetic Radiations: Waves and Particles.

Such an array of interesting topics ought to commend this book to everyone interested in general science.

Laboratory and Workbook Units in Chemistry. By *Maurice U. Ames*, Chairman Department Physical Science, George Washington High School, New York City, and *Bernard Jaffe*, Chairman Department Physical Science, Bushwick High School, New York City. 1935. "Nonconsumable Edition." $1.08. 242 pp. "Consumable Edition." $0.84. 228 pp. Silver, Burdett Company, New York.

The two authors have collaborated in producing these twin volumes, the one to be kept as a permanent guide (perhaps for the teacher), the other to be used day by day by the student. One is called "Nonconsumable," the other "Consumable." The large perforated sheets of the latter volume are attractive, spacious and ready for use.

More than fifty Units are provided. These deal with the fundamentals of Chemistry, as well as with some of the very practicable and attractive things of modern life. Warnings against dangerous chemical compounds are conspicuous; illustrations are abundant and clear; and questions, good references, tables and excellent data abound. Even the inside cover-pages are utilized in the presentation of valuable materials.

Chemistry is always an important and an attractive study. Such books as these should make it much more so.

NEW EDUCATIONAL BOOKS

We acknowledge receipt of the following publications of interest to the readers of EDUCATION. Mention here does not preclude review in this or subsequent numbers of EDUCATION.

How to Judge Motion Pictures and How to Organize a Photoplay Club. By *Sarah McLean Mullen*, with a Foreword for Teachers by *William L. Lewin*. 64 pp., paper, 25c. Published by *Scholastic*, Pittsburgh.

Mathematics in Life. Unit B, Constructions; Unit C, Drawing to Scale, and Unit D, Per cents. By *Raleigh Schorling*, Head of the Department of Mathematics, The University High School, and Professor of Education, University of Michigan, and *John R. Clark*, The Lincoln School, Teachers College, Columbia University. 1936. Kraft paper, iv and 60 pp., 28c. World Book Company.

Aid to Reading for Adults. Third Book. Government. By *Gertrude M. S. McClintock*, in collaboration with *Maude E. Aiton*, Public Schools, Washington, D. C. 1935. 343 pp., paper. $1.75. Edward Brothers, Inc., Ann Arbor, Michigan.

Aid to Reading for Adults. First Book. By *Gertrude M. S. McClintock*, in collaboration with *Maude E. Aiton*, Public Schools, Washington, D. C. 1934. 168 pp., 75c. Edwards Brothers, Inc., Ann Arbor, Michigan.

Aid to Reading for Adults. Second Book. By *Gertrude M. S. McClintock*. 228 pp., paper, 75c. Edwards Brothers, Inc., Ann Arbor, Michigan.

The following have been received from the Bureau of Publications, Teachers College, Columbia University, in their Contributions to Education Series. All are in cloth binding at $1.50 each.

No. 658. **Occupational Ability Patterns.** By *Arthur F. Dodge*, Ph. D.

No. 659. **A Study of Some Aspects of Satisfaction in the Vocation of Stenography.** By *Margaret Sidney Quayle*, Ph.D.

No. 660. **An Analysis of Certain Traits of Selected High-School Seniors Interested in Teaching.** By *Tressa C. Yeager*, Ph. D.

No. 661. **Principles and Statutory Provisions Relating to Recreational, Medical, and Social Welfare Services of the Public Schools.** By *Everett C. Preston*, Ph. D.

No. 662. **The Relationship of City Planning to School Plant Planning.** By *Russell A. Holy*, Ph. D.

No. 663. **Purposes and Conditions Affecting the Nature and Extent of Participation of Adults in Courses in the Home Study Department of Columbia University.** 1925-1932. By *George Baxter Smith*, Ph. D.

No. 665. **A Factorial Analysis of Ability in Fundamental Motor Skills.** By *Lloyd M. Jones*, Ph. D.

No. 667. **Extra-Curricular Activities in Relation to the Curriculum.** By *Galen Jones*, Ph. D.

The Physical World. By *Louis H. Heil*, Ph. D., Associate Professor of Electrical Engineering and Physics, Ohio University. With 426 illustrations. 1936. 566 pp., cloth. $2.75. P. Blakiston's Son & Co., Inc.

Introduction to Home Economics. Compiled by *Elizabeth F. Lillie*, School of Home Economics, Oregon State College. 57 pp., planographed. Oregon State College, 1935.

Creative Re-Education. By *Frederick Peterson*, M. D., LL.D. 1936. 112 pp., cloth. $1.00. G. P. Putnam's Sons.

Psychology of Adolescence. By *Luella Cole*, Ph. D. 1936. 503 pp., cloth. Farrar & Rinehart. $3.00.